TM 11-937

WAR DEPARTMENT TECHNICAL MANUAL

POWER UNIT PE-183-A

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No person is entitled solely by virtue of his grade or position to knowledge or possession of classified matter. Such matter is entrusted only to those individuals whose official duties require such knowledge or possession. (See also paragraph 23b, AR 380-5, 15 March 1944.)

WAR DEPARTMENT *15 DECEMBER 1944*

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This manual supersedes Preliminary TM 11-937, 1 November 1943.

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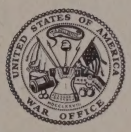

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WAR DEPARTMENT,
WASHINGTON 25, D. C., 15 December 1944

TM 11-937, Power Unit PE-183-A, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
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OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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(For explanation of symbols see FM 21-6.)

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DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut —Use axes, handaxes, machetes.

3. Burn —Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives—Use fire arms, grenades, TNT.

5. Disposal —Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. Smash—Radiator, fuel tank, generator and exciter frame, oil filter, magneto, fuel pump, water pump, cylinder head, cylinder block, air cleaner, muffler, carburetor, fuel strainer, governor, manifolds, blower fan, control panel instruments, and terminals on panel.

2. Cut —All cables, control panel wiring, ignition wires, fuel pipes, generator windings, exhaust tube, radiator hose, and all other wires or cables used in or on the unit.

3. Bend and/or break—Unit housing, control cabinet, cable, reels, battery box and contents, and unit base.

4. Burn —Wire and cable, fuel, oil, and this technical manual.

5. Bury or scatter—Any or all of the above pieces after destroying their usefulness.

DESTROY EVERYTHING

SAFETY NOTICE

This equipment generates high voltages that are dangerous to life. Operators must be very careful and observe every safety regulation at all times. If necessary to adjust equipment, proceed according to instructions, take no chances.

Always open the CIRCUIT BREAKER before changing load connections.

Do not touch the commutators, brushes, and brushholders with the bare hands while the armature is revolving.

Never remove the covers on the generator while the unit is in operation.

Always stop the unit before removing the gasoline-tank filler cap.

Never spill gasoline on a hot engine.

Always provide sufficient ventilation of the engine exhaust. The exhaust gases contain carbon monoxide which is odorless and a deadly poison.

Use respirator, if available, when moistureproofing and fungiproofing the equipment as varnish spray may have toxic effects. If respirator is not available, fasten cheesecloth or other cloth material over nose and mouth.

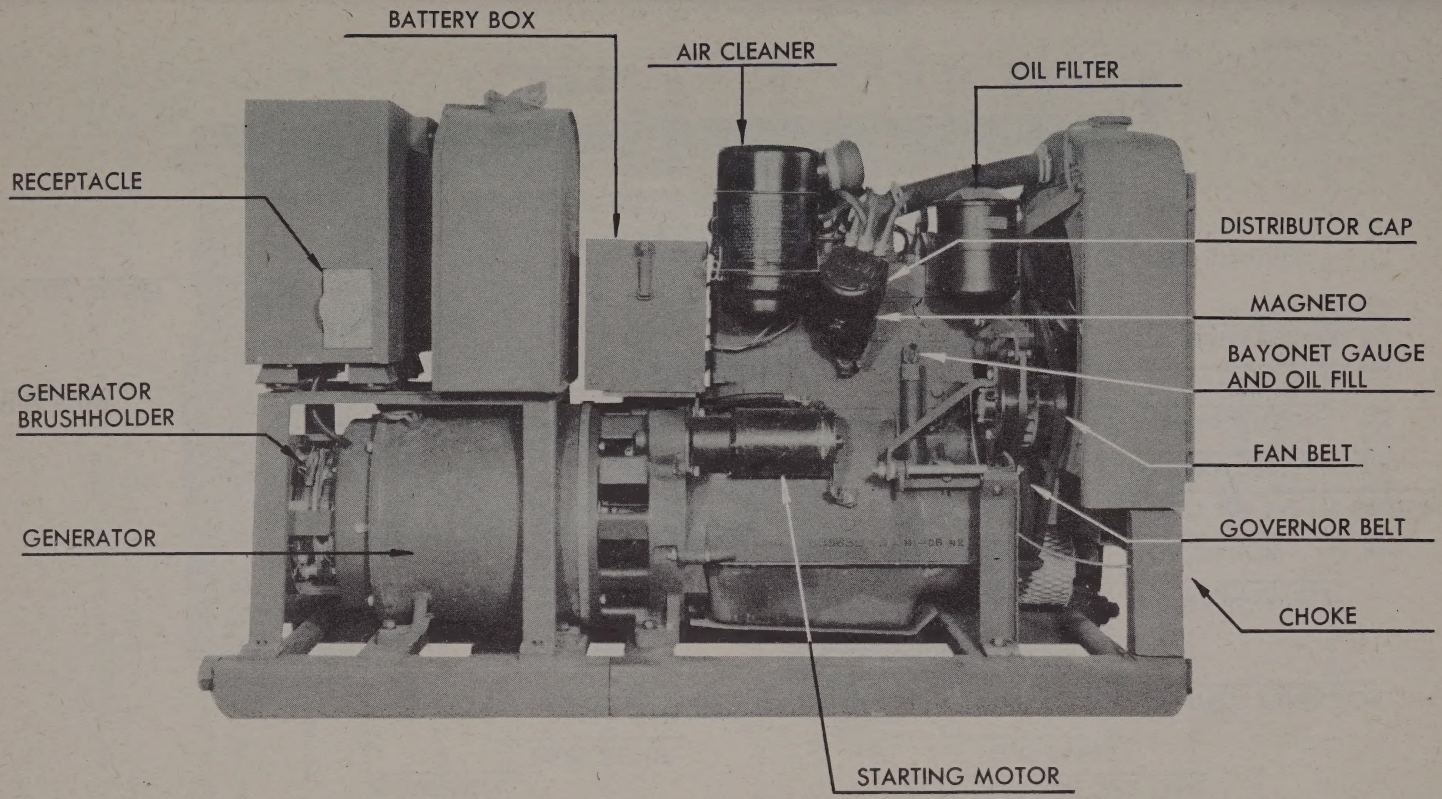

Figure 1. Power Unit PE-183-A, magneto side.

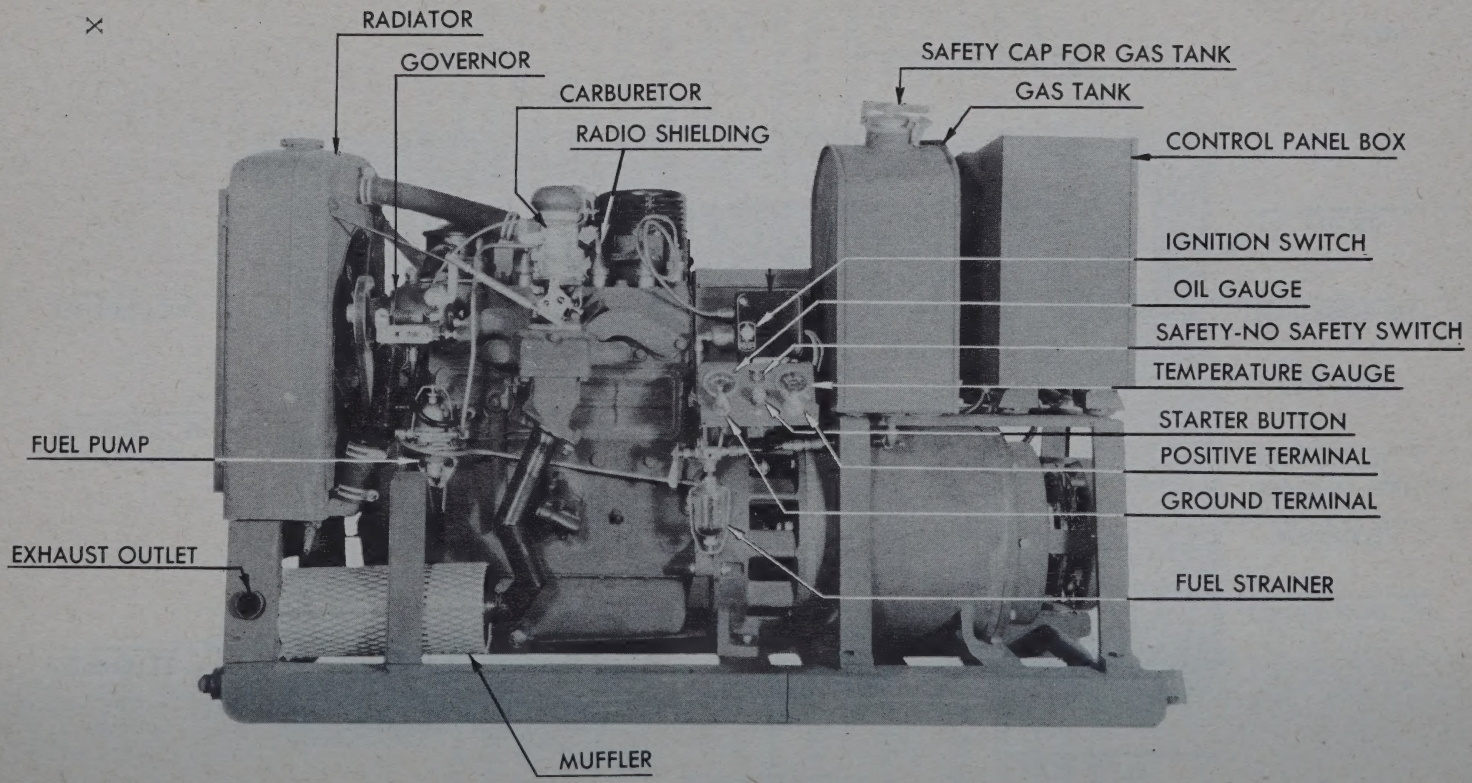

Figure 2. Power Unit PE-183-A, engine control side.

RESTRICTED

This manual supersedes Preliminary TM 11-937, 1 November 1943.

SECTION I
DESCRIPTION

1. GENERAL.

a. Power Unit PE-183-A (figs. 1 and 2) is a self-contained power plant consisting of three main components: a gasoline engine, a power generator, and a control panel. The entire assembly is mounted on a welded, steel skid base (fig. 4). The Power Unit PE-183-A is a 6.3-kilovolt-ampere, 0.8-power factor, 5-kilowatt, 120-volt, single-phase, 52.5-ampere unit. The gasoline engine is directly connected to the exciter end of the generator.

b. The speed of the power unit is controlled by a precision governor (fig. 2). At no load, the speed is approximately 1,805 rpm. At 6.3 kva, 0.8 power factor, 52.5 amperes, 120 volts, the speed is approximately 1,800 rpm. With a load as above, and the rheostat set for 208 volts, the no-load voltage will be approximately 128 volts.

2. ENGINE.

a. Rating. The engine is a vertical L-head, 4-cylinder, 4-cycle liquid-cooled unit. It has a $3\frac{1}{8}$-inch bore, a $4\frac{3}{8}$-inch stroke, a 134.2-cubic-inch piston displacement, and a compression ratio of 6.48 to 1. The maximum brake horse power is 31 at 1,800 rpm; the compression pressure is 111 pounds at cranking speed of approximately 185 rpm. The firing order is 1-3-4-2.

b. Cooling. The engine is cooled and maintained at normal operating temperature by a water cooling system. Water circulation is provided through the water jackets in the engine block and through the radiator by a centrifugal water pump. The radiator in turn is cooled by a 16-inch, 6-blade, pusher-type fan, driven by a V-belt from the engine crankshaft.

c. Ignition. Ignition is provided by a high-tension magneto (fig. 1). The entire ignition system is shielded to reduce radio interference.

d. Fuel System. (1) The fuel system consists of a fixed-jet, float-feed carburetor, fuel pump, fuel strainer, and three-way fuel

valve. This valve permits drawing fuel from either the built-in fuel tank or remote fuel tank.

> **NOTE:** Twenty feet of flexible fuel line is provided, together with a ½-inch, round, plated steel pipe of sufficient length to reach the bottom of a 50-gallon drum. The flexible fuel line is equipped with an identical fitting at each end. A vented adapter and packing nut are provided for fitting the ½-inch pipe through the large hole of a standard fuel drum.

(2) The gasoline tank (fig. 2) above the generator has an indicating fuel gauge and a hinged filler cap. The carburetor is provided with an air filter of the oil-bath type to prevent the entry of dust and dirt.

e. Lubricating System. Lubrication for the engine is provided by a gear-type pump mounted on the carburetor side of the crankcase. This pump circulates lubricating oil under pressure to all main and connecting rod bearings. All other bearing surfaces and moving parts within the engine are spray-lubricated from the bleed from the engine bearings. The oil is circulated through an oil filter (fig. 1), mounted on the magneto side of the engine, which prevents the circulation of any foreign matter that may be picked up by the lubricating oil.

f. Starting System. The unit may be started either by means of a hand crank or an automotive type electric starter with Bendix drive. As the unit lacks a starting battery, provision is made for connecting an external battery. The power unit is not equipped with a charging generator, so recharging of the battery must be accomplished by operation in motor vehicles or by an adjacent maintenance unit which has battery-charging equipment.

3. GENERATOR.

a. The Generator. The generator, shown in figure 20, is a 6.3-kva, single-phase, a-c unit of the revolving field type, with an in-built exciter. It is designed to generate 60 cycles, 120 volts when driven at 1,800 rpm. The d-c exciter for separate excitation is mounted on the same shaft as the alternator rotor. Voltage is controlled by a hand-operated rheostat on the control panel. The generator is designed to give good regulation and overload capacity. It is so constructed that it will not be harmed if operated as long as 2 hours at 25 percent overload.

b. Generator Exciter Field. The exciter field is built inside

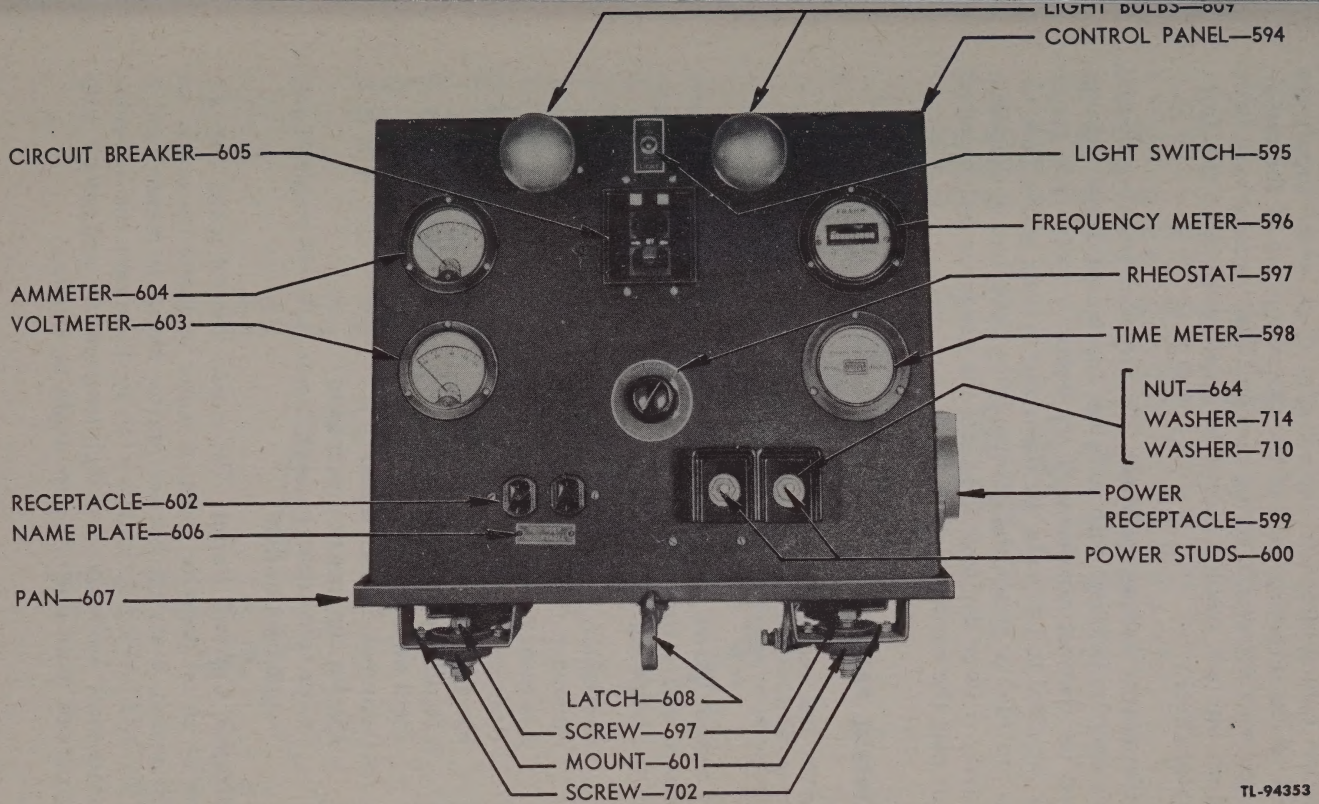

Figure 3. Control panel, front view.

the front bearing bracket of the generator. The brushholders for the exciter commutator and the collector rings, which supply the current to the revolving field of the alternator, are of the radial-box type with adjustable spring tension. They require very little attention but are readily accessible upon removal of the front generator cover.

c. Generator Armature Shaft. The armature shaft is mounted on two oversize bearings with sufficient movement of the bearings allowed for thermal expansion of the shaft. A screw-type grease cup is provided to lubricate the rear main bearing and a Zerk fitting is provided to grease the bearing at the other end of the armature shaft. A large-diameter fan cools the generator by propelling cool air past the windings.

4. CONTROL PANELS.

NOTE: The control equipment necessary for the operation and control of the generating unit is mounted on two panels. This equipment is indicated by lettering engraved on the panels.

a. Control Panel Assembly. A self-contained control cabinet is mounted above the generator assembly. The panel (fig. 3) consists of the following:

1	Voltmeter, 0-150 a-c
1	Ammeter, 0-60 a-c
1	Frequency meter, 58-62 cycles
1	Running time meter
2	Panel lights
1	Circuit breaker, single-pole, 70-amp thermal overload
1	Field rheostat
1 set	Terminals (power studs)
1	Duplex convenience receptacle
1	Power receptacle (Hubbell 2-pole, 120-volt single-phase)
1	Toggle light switch

b. Engine Control Panel. The engine control panel (fig. 2), consists of an oil pressure gauge, a water temperature gauge, an ignition switch, a starter button, starter motor terminals, and a SAFETY-NO SAFETY toggle switch to disconnect the low-pressure emergency stop and the high-temperature emergency stop during periods when loss of power might be serious.

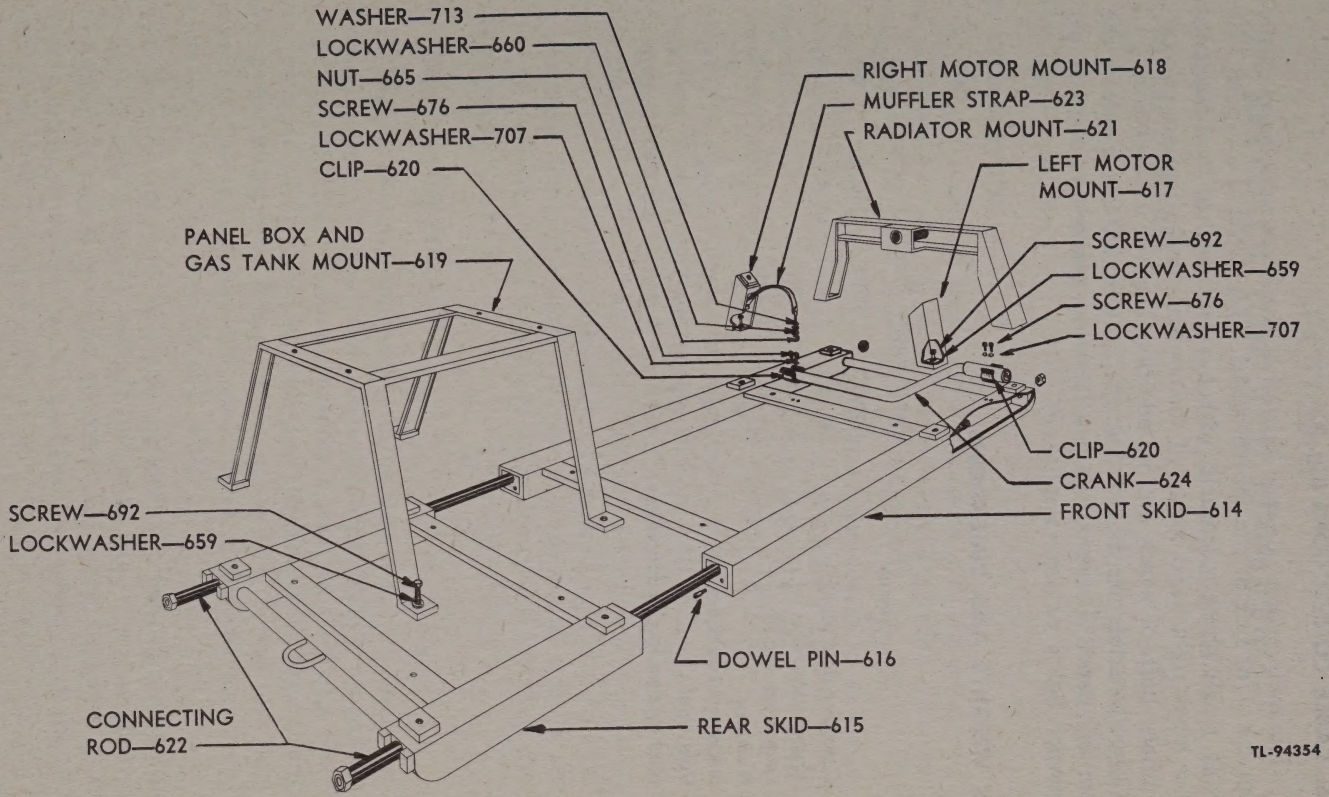

Figure 4. Skid assembly and mounts.

5. CABLE CONNECTIONS (fig. 3).

The main power outlet is located at the lower right-hand corner on the right side of the control panel. This outlet is a 3-pole, 120-volt, single phase receptacle, with a cover attached by a hinge. In the lower right-hand corner of the control panel there are two terminals, both of which are for additional power connections. Two 120-volt outlets are mounted at the bottom, left-hand side of the control panel. These outlets are for the attachments of tools, extension lights, or other appliances.

6. WEIGHTS AND DIMENSIONS.

Component	Dimensions in Feet and Inches			Weight (lbs.)
	Length	Width	Height	
Complete unit (dry)	4′ 11″	2′	3′ 4½″	1035
Engine assembly	2′ 6½″	1′ 10½″	2′ 7″	546
Generator assembly	2′ 4″	1′ 2½″	1′ 2½″	281
Radiator	9″	1′ 8″	2′	35
Control box assembly	9¾″	1′ 8½″	1′ 9¾″	53
Fuel Tank	1′ 8¼″	8½″	1′ 8″	18
Skid base and welded mounts	4′ 11″	2′	1′ 1¾″	102

SECTION II
INSTALLATION AND OPERATION

7. INITIAL PROCEDURE.

Before attempting to install Power Unit PE-183-A inspect the unit for possible damage or missing parts. Report any damage or shortage immediately.

8. INSTALLATION.

a. Choose a location that will be consistent with the assignment to be carried out and the length of the attaching cables. The unit may be operated either indoors or out-of-doors.

b. If the unit is to be operated out-of-doors with its skid base on the ground, select a dry, level spot. Avoid low ground which may be flooded by sudden rain. Always place the unit so that exhause gases are carried away from the operating personnel.

c. If the unit is to be operated within a building, make certain that there is adequate ventilation to carry off escaping exhaust fumes and provide an ample supply of oxygen. Locate the unit so that the exhaust may be carried out of the building with the fewest number of bends in the exhaust line. All exhaust connections must be gas tight. Provide at least two feet of space on all sides of the unit. These instructions also apply when the unit is installed in a trailer or other vehicle.

9. PREPARATION FOR USE.

a. Inspect the unit thoroughly to be sure that it is in proper working order. Check all fuel and wire connections to be certain that they are secure. Tighten any loose screws, nuts or bolts. With the ignition OFF, turn the engine a few times with the hand crank. All parts should move freely. If the unit is new, or has just been taken from storage, remove all seals from the carburetor air intake, exhaust outlet, crankcase breather, etc.

b. Before filling the fuel tank, perform the following preparations: (1) Withdraw the bayonet oil gauge (fig. 1) and check the oil supply. If the oil is not up to the FULL mark, replenish it; if empty, fill the crankcase with 5 quarts of oil according to the following schedule:

Temperature	*Oil*
Above 32° F.	OE SAE 30
32° F to 0° F.	OE SAE 10
Below 0° F.	See Note

NOTE: When the temperature is below 0° F, fill the crankcase with 75 percent OE 10 and 25 percent gasoline thoroughly mixing in separate container before placing in the crankcase.

(2) Be sure that the oil pan drain plug is closed.

(3) Lubricate the starting motor (fig. 25) by placing 6 drops of engine oil in the oil cup on the front end. Lubricate all exposed moving control parts with light engine oil.

(4) Wipe off the entire unit, being certain that all radiator air passages and cooling fins are free from foreign matter.

(5) Remove the base of the air cleaner to see that it is clean. Fill the air cleaner bowl to the indicated level and replace it on the unit.

(6) Blow out any dust and dirt from the inside of the control cabinet and the back of the control panel.

(7) Fill the fuel tank with 10 gallons of clean gasoline, free from water and other foreign matter. The air vent in the fuel tank cap should be clear.

(8) Fill the radiator with 13 quarts of clean water, free from any foreign matter that might clog the cooling system.

(9) If the unit is to be operated in freezing temperatures, fill the cooling system about one-quarter full with clean water. Then add sufficient Compound, Antifreeze (ethylene-glycol type), U. S. Army Spec 4-1116 to protect against temperatures at least 10° F below the lowest anticipated temperature, according to the following chart:

Lowest temperature expected Degrees Fahrenheit	Amount of antifreeze compound Pints
+ 10	7
0	9
— 10	11
— 20	12½
— 30	14
— 40	16
— 50	18

Add water until the radiator is nearly full, then run the engine until the normal operating temperature is reached. Stop the engine and test the solution with an accurate hydrometer. To check the accuracy of a hydrometer use one part of antifreeze compound to two parts of water. This solution should produce a hydrometer reading of 0° F.

(10) The operating temperature of the unit depends upon a number of conditions. Special attention should be made to maintain the proper operating temperature between 140° F and 180° F.

10. OPERATION.

Recheck the operations previously outlined (par. 9) to be certain that all of the instructions have been followed. Start the engine with either the crank or a battery.

a. Manual Starting. To crank the unit by hand, proceed as follows: (1) Turn the small knob of the ignition switch (fig. 2) to the ON position. This knob is located on the Penn electric switch on top of the engine control panel.

(2) Be sure that the SAFETY-NO SAFETY toggle switch on the engine control panel is in the SAFETY position.

(3) Remove the hand crank from the side of the left-hand skid beneath the starting motor. Insert it in the hole in the center of the radiator mount on the radiator end of the unit and rotate it until it engages the starting pin in the end of the crankshaft. Choke the carburetor if necessary

(4) Pull up quickly on the starting crank. The unit should start. If the unit does not start on the first or second attempt, the carburetor may be flooded. If the unit fails to start after several attempts, refer to the trouble chart (par. 62) for the possible cause.

> **CAUTION:** When cranking, do not place fingers around the radiator. The radiator fan may cause serious injury. NEVER spin or push down on the crank as serious injury to the operator may result if the engine should backfire.

b. Battery Starting. If the engine is to be started with a battery, proceed as follows: (1) Remove the 8-foot battery cables from the battery box and attach them to a standard 6-volt battery. Attach the negative lead to the ground terminals on the en-

gine control panel. Attach the positive side of the battery to the positive terminal.

(2) Connect the load to the HUBBELL power receptacle on the right-hand side of the generator control box (fig. 3).

(3) See that the circuit breaker is in the OFF position.

(4) Turn the small knob of the ignition switch to the ON position.

(5) Place the SAFETY-NO SAFETY toggle switch on the engine control panel in the SAFETY position.

(6) Push the starter button to start the engine.

(7) Choke the carburetor if necessary. Very little choking is needed. If the engine fails to start in 15 to 20 seconds of cranking, or if it should suddenly stop, shut off the switches and look for the cause. Consult trouble and remedy chart, par. 62.

c. Operating Under Load. (1) CIRCUIT BREAKER. After the engine has been started and is operating satisfactorily, throw the load across the generator by turning the circuit breaker to ON. This automatically disconnects the generator from the load if any trouble (generally a short circuit) develops. It resets immediately when thrown to the ON position again and throws out if the trouble has not yet been cleared. Clear any trouble that develops before further use.

(2) VOLTMETER. The voltmeter is connected in the circuit ahead of the circuit breaker and reads the line voltage at all times. If the power unit is running and the voltmeter does not register, check the generator before proceeding further.

(3) AMMETER. The ammeter is placed in each phase of the load circuit and indicates the load of that phase.

(4) LOAD. Normal load or rating for a balanced load is 52 amperes for 120 volts on single-phase, 60-cycle operation. The generator will not be harmed, though, even if it is operated for as long as two hours at 25% overload.

d. Changing Frequency. Change the speed of the engine to conform to the speed necessary to give the frequency desired. The engine speed is controlled by a mechanical governor (fig. 5), belt-driven from the pulley on the crankshaft. This governor is of the

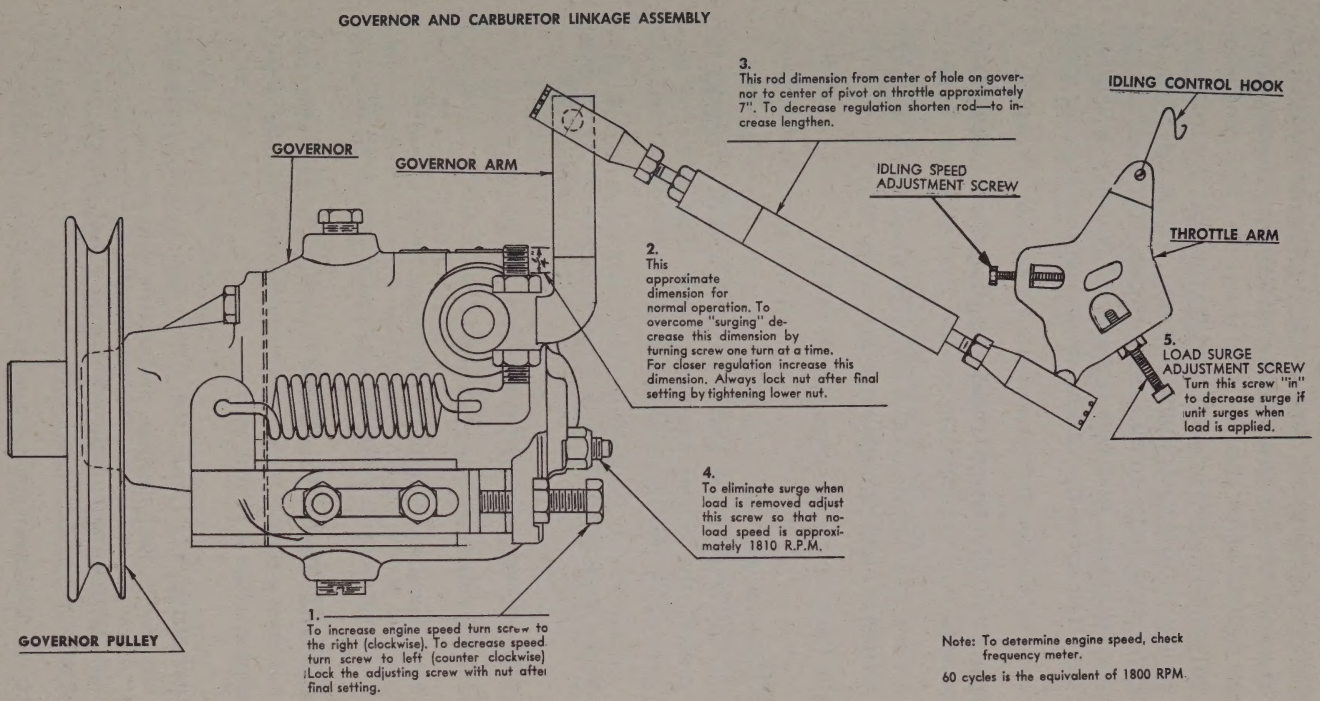

Figure 5. Governor adjustment instructions.

fly-ball type, operating in oil, and is easily adjusted for 60-cycle generator operation. The engine speed is checked by the frequency meter on the control panel (fig. 3). The speed is 1,800 rpm when the meter indicates 60 cycles. Upon starting the unit the frequency may read as low as 58.0 cycles until the unit warms up, then the frequency climbs gradually to 59.5 or 60 cycles. If it does not rise to the proper 60 cycles, and this operating frequency is desired, adjust the governor speed by turning the governor adjusting screw (fig. 5 (1)).

e. Stopping. (1) Remove the load by pulling the circuit-breaker to OFF position.

(2) Pull over the idler spring on the carburetor and catch it on the hook (fig. 5) located on the carburetor assembly.

(3) Turn the knob on the ignition switch to OFF.

11. STORING.

If the unit has been in use and is to be stored or prepared for shipment, protect the engine against rusting. The following materials and procedures are recommended.

a. Materials Required. (1) Oil, Engine OE U. S. Army Spec 2-104

(2) Oil, Engine, Preservative Ordnance Spec AXS-934

(3) Oil, Flushing Ordnance Spec AXS-979

(4) Compound, Insulation, Ignition Ordnance Spec AXS-858

(5) Tape, Nonhygroscopic, Adhesive Ordnance Spec AXS-871

b. Repairs and Tests. Check the operation of the unit and make any necessary repairs before rustproofing for storage. Rustproof the engine while it is still warm.

c. Rustproofing. (1) Drain the entire fuel system, including fuel tank, fuel pump, fuel strainer, carburetor, and gas lines.

(2) Drain the lubricating system and insert a full charge of preservative engine oil, AXS-934, grade 1.

(3) Remove spark plugs.

(4) Rotate the engine several times, by means of the starting motor or the hand crank, to insure proper distribution of the preservative oil.

(5) Using an air-atomizing type spray gun, spray preservative engine oil into each cylinder while the engine is rotating. This will protect cylinder walls, valve head and stems, and valve guides. Approximately two tablespoonsful of the preservative oil will be required for each cylinder.

NOTE: Do not pour the preservative oil through the carburetor.

(6) Remove the valve cover plate (par. 39) and spray preservative oil over the push rods, rocker mechanism, interior of valve cone, and between the cylinder block and side plate.

(7) Spray preservative oil into the oil filler and the crankcase breather.

(8) Replace spark plugs.

NOTE: If the unit is to be moisture-vapor packed, including a dehydrating agent, replace the original spark plugs with dehydrating plugs.

(9) Drain the preservative oil from the crankcase.

(10) Attach a red tag to the oil filler cap which reads:

CAUTION: THIS ENGINE HAS BEEN RUST-PROOFED. DATE:..... USE ENGINE OIL CONFORMING TO U. S. ARMY SPECIFICATION 2-104, SEASONAL GRADE, WHEN PLACING ENGINE IN SERVICE.

(11) After the engine has cooled, clean grease and dirt from the exterior of the engine.

(12) Seal the following openings with nonhygroscopic, adhesive tape, AXS-981.

(*a*) Air intake.

(*b*) Crankcase breather.

(*c*) Exhaust opening.

(13) Be sure that all surfaces are dry. Then spray all exterior surfaces of the engine and accessories, including wiring and electrical equipment, with ignition-insulation compound, AXS-858.

NOTE: Store the unit in a closed building if possible.

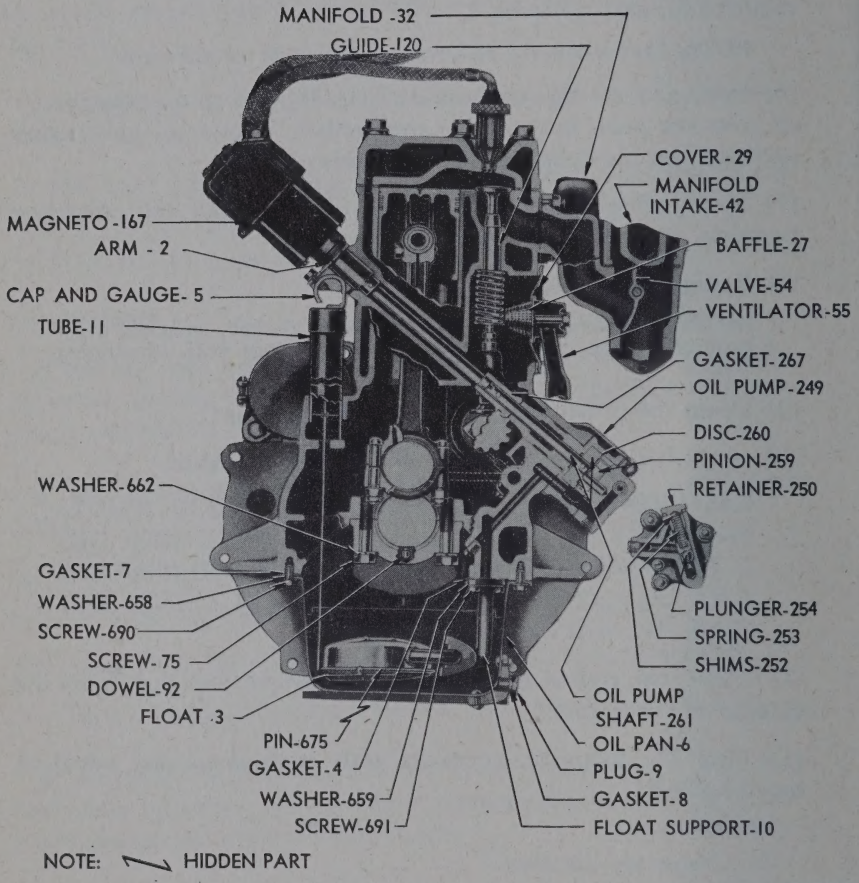

Figure 6. Engine, front sectional view.

SECTION III
FUNCTIONING OF PARTS

12. ENGINE.

a. Four-stroke Cycle. The engine (figs. 6 and 7) used in Power Unit PE-183-A is a conventional automotive type of internal-combustion, gasoline engine. It develops power by burning a mixture of gasoline and air under compression in the cylinders and applying the resulting expanding force on the heads of the pistons. The resulting downward motion of pistons is transmitted through connecting rods to the crankshaft, resulting in rotary motion of the crankshaft. This engine operates on the usual four-stroke-cycle principle, the action of which may be considered as being a repetition of a cycle of four different strokes. The action of each cylinder is the same, but is 180° of crankshaft travel later than that of the preceding cylinder. Firing order is 1-3-4-2.

(1) INTAKE STROKE. The piston travels downward while the intake valve is open and the exhaust valve is closed. The resulting reduction in pressure within the cylinder allows air to rush in through the air cleaner, carburetor, intake manifold and intake valve port. As the air passes through the carburetor, the proper proportion of gasoline is mixed with it.

(2) COMPRESSION STROKE. The piston travels upward with both valves closed and compresses the fuel mixture in the combustion chamber at the upper part of the cylinder. As the piston reaches the top of the stroke a spark occurs at the spark plug and burning of the fuel mixture begins.

(3) POWER STROKE. Burning of the fuel mixture continues, developing great heat and pressure. Both valves are closed. The piston is forced downward, transmitting its power to the crankshaft.

(4) EXHAUST STROKE. The piston travels upward with exhaust valve open, intake valve closed, and forces the exhaust gases from the cylinder. These gases pass out through the exhaust port, exhaust manifold, exhaust pipe and muffler (fig. 8 (445)).

b. Power. The amount of power developed by the engine, and hence its speed under a given load, is determined by the position of the throttle valve in the carburetor which regulates the amount of fuel mixture that enters the cylinders. The throttle valve is automatically controlled by the engine governor.

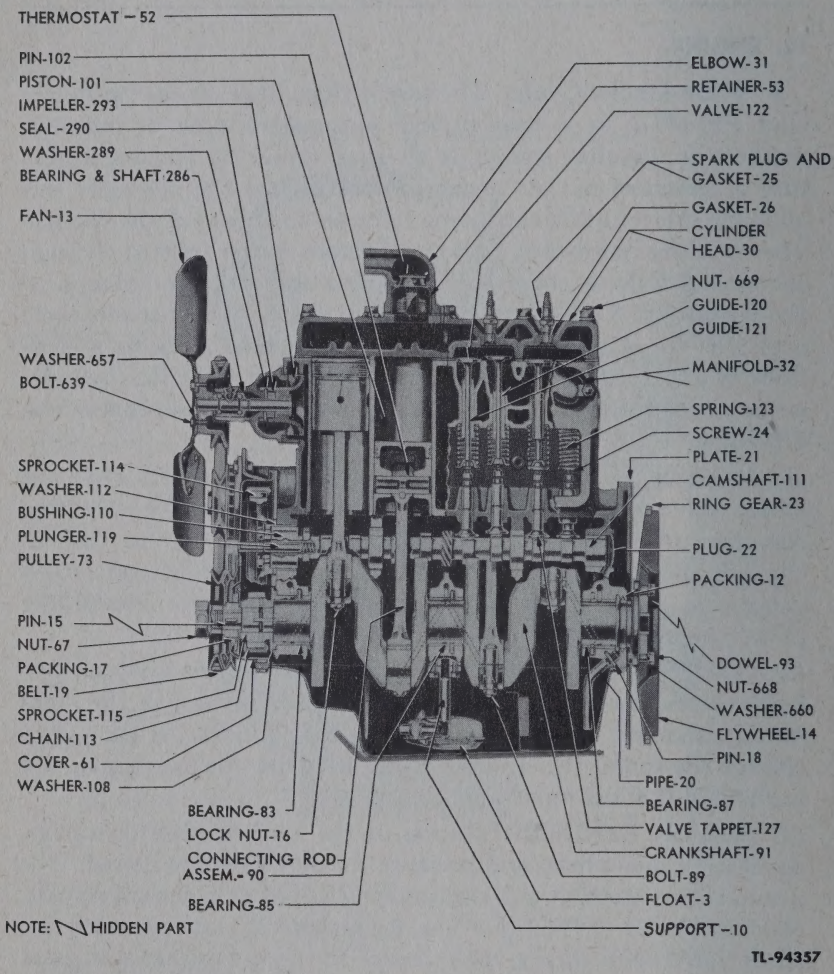

Figure 7. Engine, side sectional view.

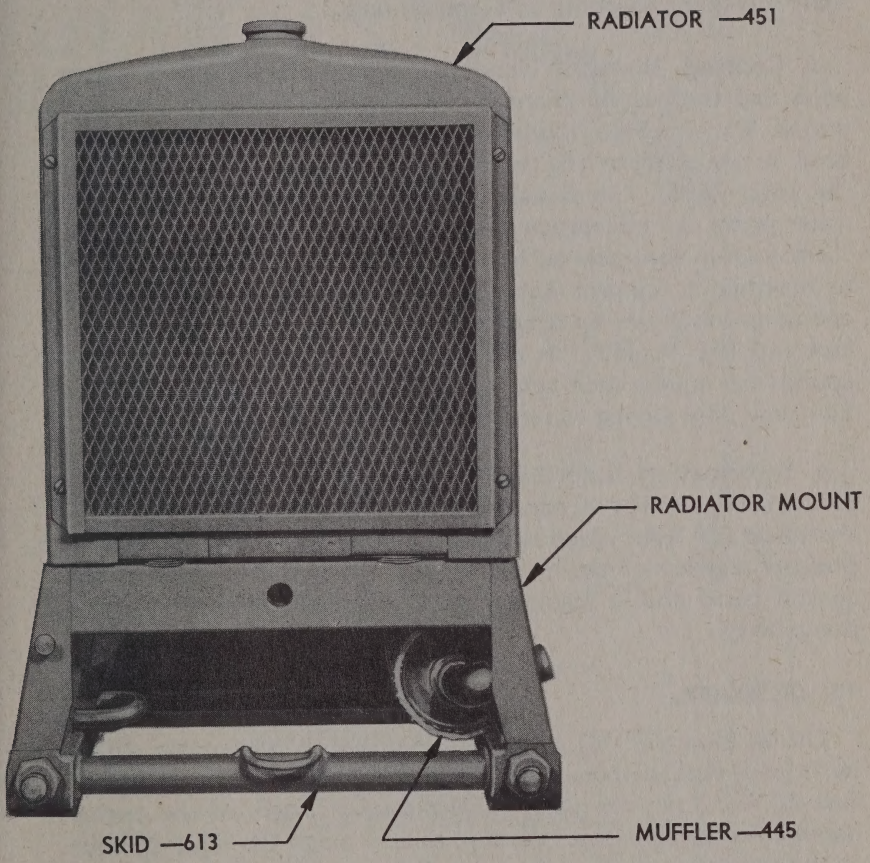

Figure 8. Power Unit PE-183-A, from radiator end.

c. Valves and Camshaft. The valves are operated in proper sequence and timing by tappets which ride on a series of cams on the camshaft. The camshaft is driven by a chain from a sprocket on the crankshaft and turns at just half the speed of the crankshaft. The valves are closed by spring action. A gear on the camshaft drives the oil pump and ignition unit.

d. Cooling. Water is circulated around the cylinders, valve ports and combustion chambers to conduct heat away from the engine. The water flows from the outlet at the top of the cylinder head, to the radiator (fig. 8) where it is cooled, then returned to the water jacket. Circulation is maintained by a centrifugal-type water pump. Air circulation is maintained by a pusher-type fan. A thermostat in the water outlet at the top of the cylinder head tends to maintain a uniform water jacket temperature under varying operating conditions by regulating the water circulation. The radiator cap (fig. 9 (452)) is designed to maintain a pressure of 4 pounds per square inch before releasing vapor through the overflow pipe, thus saving water.

e. Lubrication. Lubrication is provided within the engine by pumping oil from the oil pan to the main, connecting rod, and camshaft bearings from which it sprays to other interior parts. The oil pressure registers on the ENGINE OIL PRESSURE gauge on the control panel and is regulated by a pressure relief valve in the pump body.

13. OIL FILTER.

The oil filter (fig. 10), on the magneto side of the engine, filters particles of dust, carbon and other foreign material from the crankcase oil. Oil from the pressure lubricating system of the engine passes into the filter near the top, then through the filter and out at the bottom connection, from which it is conducted to the timing chain cover and returns to the crankcase. The filter element becomes filled after continued service with foreign material collected from the oil and no longer can perform its function. It must then be replaced with a new element. Only a portion of the oil leaving the pump passes through the oil filter, but all the oil in the crankcase passes through frequently enough to be kept in a clean condition if the filter element is changed often enough. As soon as the oil becomes dark, the element should be changed.

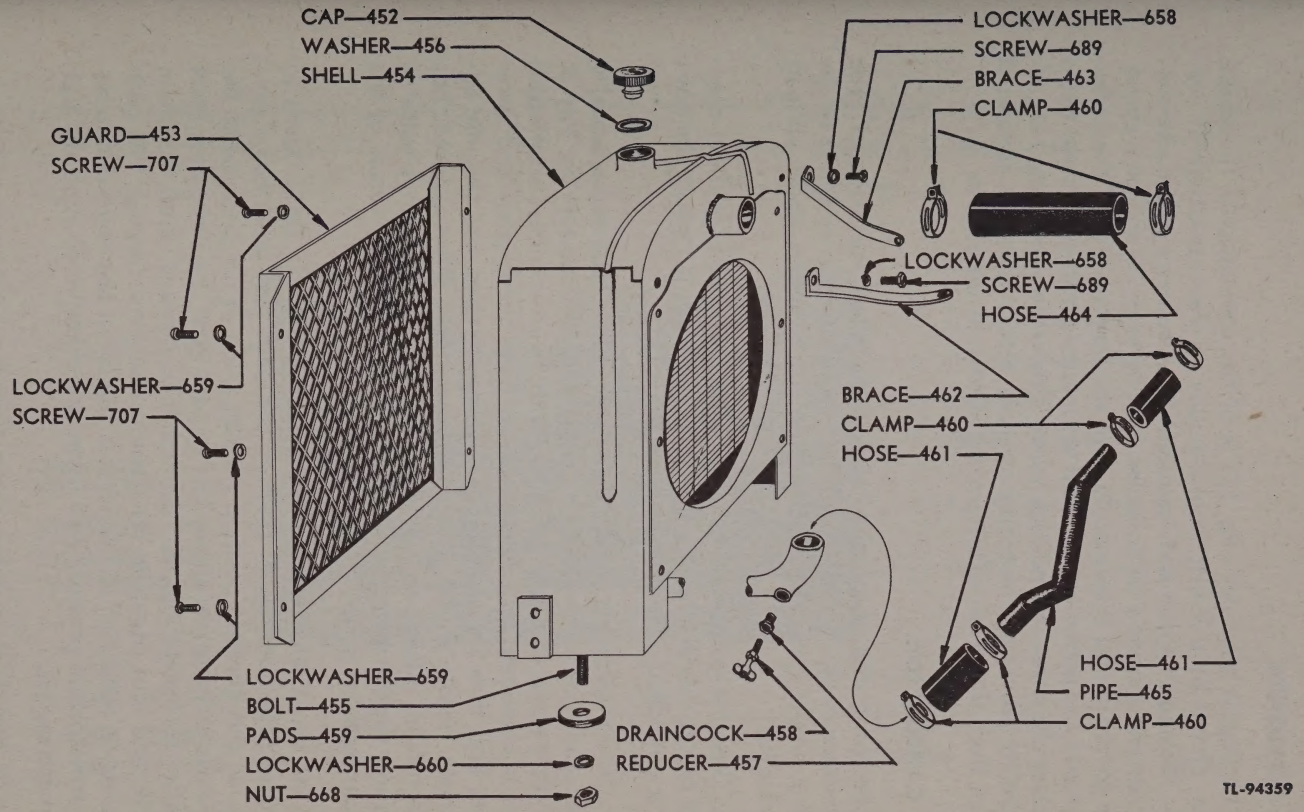

Figure 9. Radiator assembly.

14. GOVERNOR.

The engine governor (fig. 11) is of the conventional fly-weight type, driven by a V-belt from a pulley on the crankshaft. It controls the engine speed and maintains the frequency of the alternating current generator at constant load between 60 and 60.2 cycles. The governor arm is connected with the throttle arm of the carburetor and the action is such that an increase in engine speed tends to close the throttle, and vice versa. The engine speed may be adjusted by adjusting the spring tension. The governor is lubricated by oil from the pressure lubricating system of the engine.

15. CARBURETOR.

The power unit is equipped with a downdraft, metering jet-type carburetor (figs. 12 and 13), the prime function of which is to deliver a proper mixture of fuel and air to the engine under all load conditions.

a. Gasoline enters the carburetor bowl through the float-operated needle valve assembly, the level to which it rises in the bowl being controlled by the float.

b. When operating at very light load, the throttle valve is nearly closed and most of the gasoline enters the fuel mixture by way of the idle well jet, the low speed jet, and the economizer, near which point it combines with streams of air from the by-pass and lower bleed, and then through the passage to the port and the idle adjustment needle valve. This mixture is richer than required, but upon further mixing with air from the venturi provides a suitable mixture, the combined richness being adjustable by means of the idle adjustment screw.

c. At about 30 percent of full load the throttle valve opens so far that little fuel passes through the path just described. However, at this throttle position the reduction of air pressure at the tip of the main nozzle allows fuel to pass from the carburetor bowl through the metering jet, through the passage, and the main nozzle, and into the main air stream. Fuel flow through this path depends on reduction of pressure at the tip of the main nozzle below atmospheric pressure and upon the effective opening through the metering jet.

d. As the throttle valve opens further under increasing load,

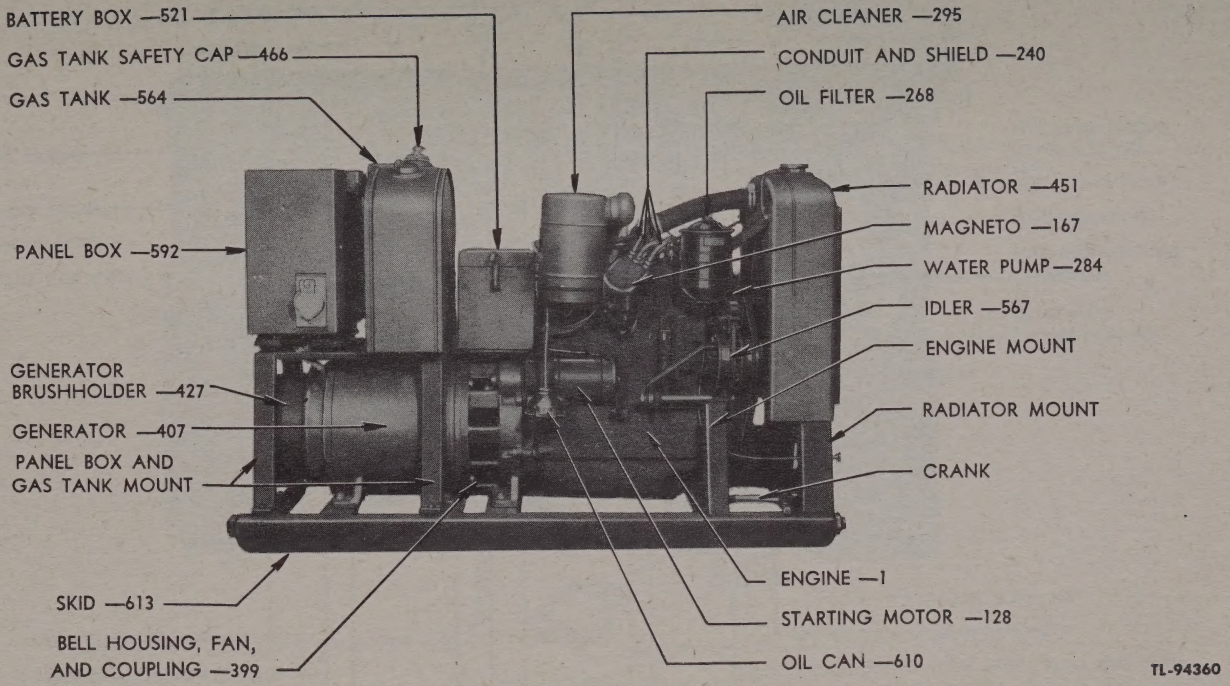

Figure 10. Major assemblies on magneto side.

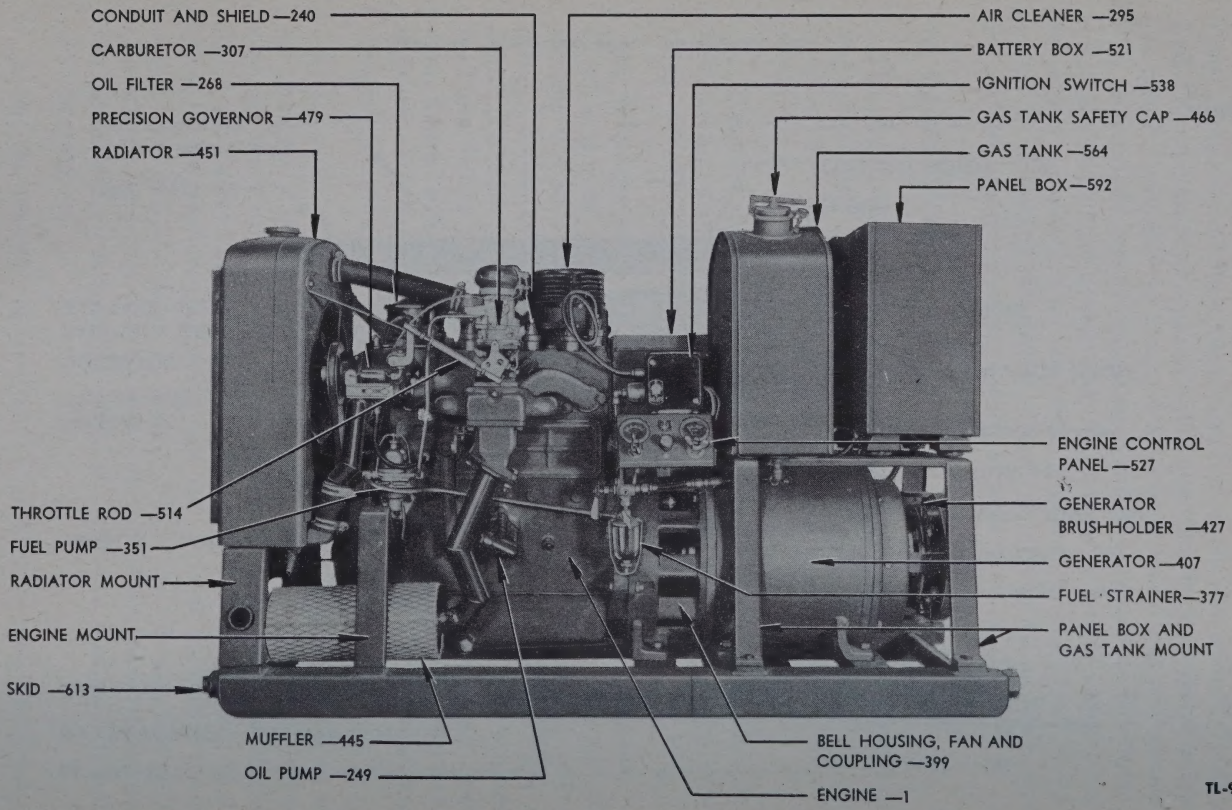

Figure 11. Major assemblies on engine control side.

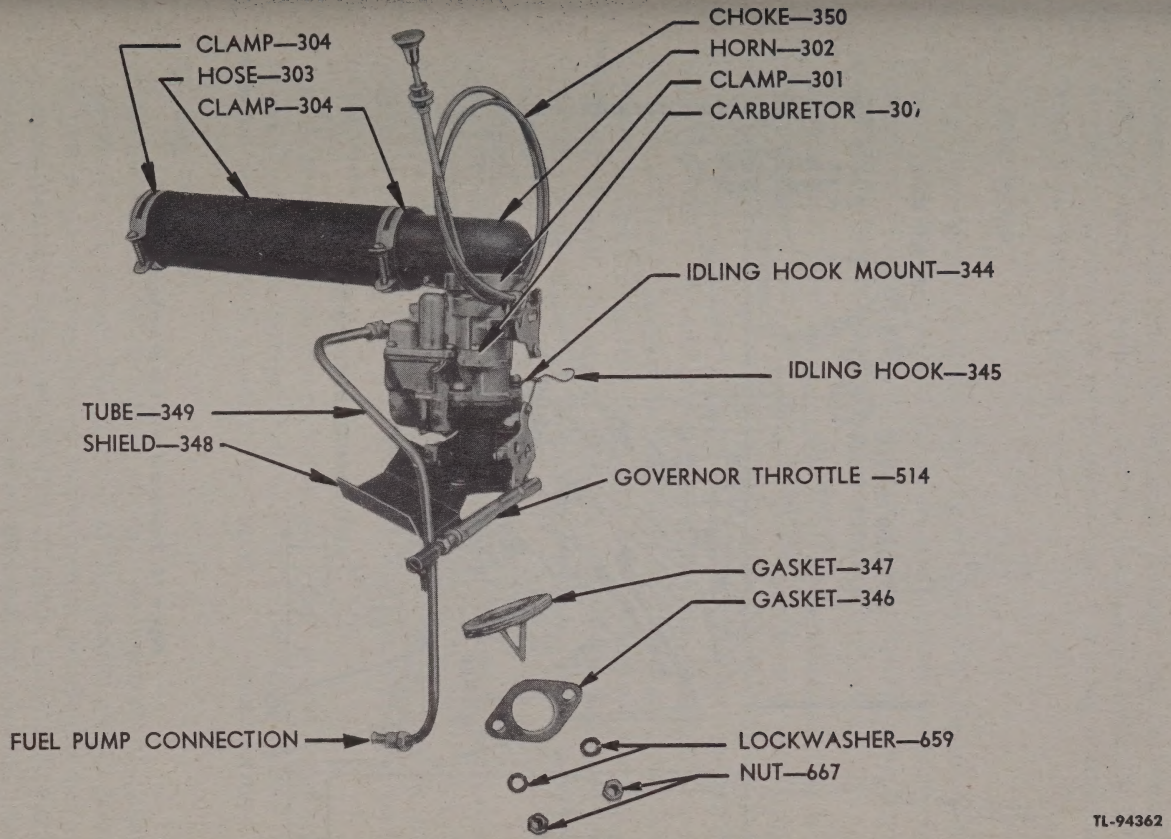

Figure 12. Carburetor assembly and connecting parts.

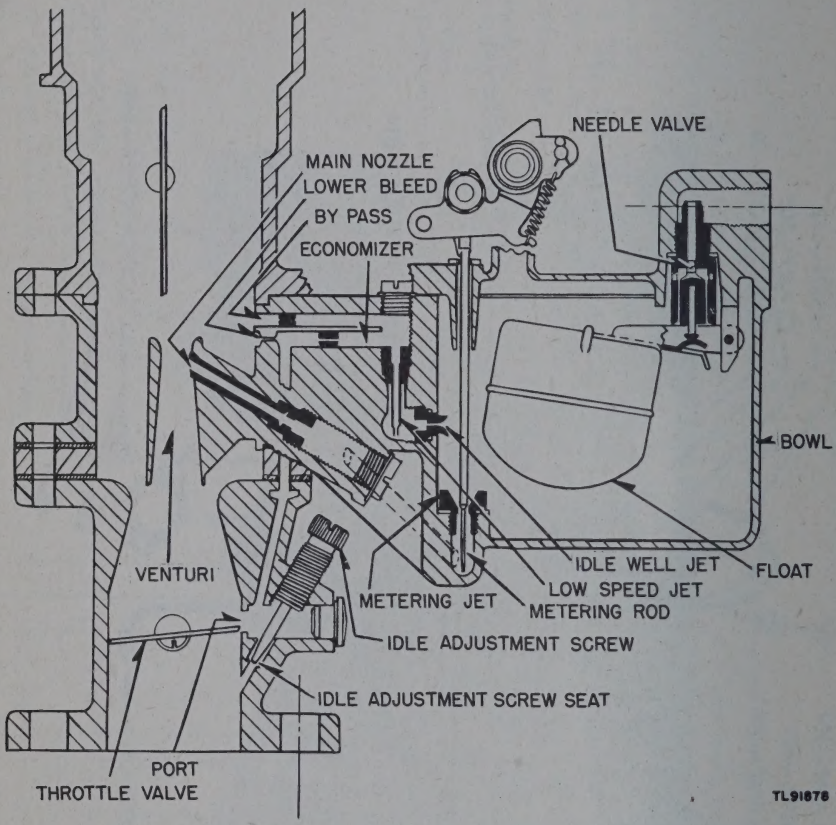

Figure 13. Functional diagram of carburetor.

the pressure at the tip of the main nozzle is further reduced and the metering rod is raised by mechanical linkage with the throttle so as to increase the effective opening through the metering jet. The various parts are so proportioned as to provide a suitable mixture at all operating loads.

16. FUEL PUMP.

The diaphragm type fuel pump (figs. 11 and 14) operates continuously while the unit is in operation and supplies fuel from the fuel tank to the carburetor. It is mounted on the right side of the engine and driven by an eccentric on the camshaft.

a. A special lever arrangement transmits motion to the diaphragm assembly. When the diaphragm assembly is drawn downward, the pressure within the pump chamber is reduced and fuel flows from the fuel tank, through the fuel line and into the pump inlet. It passes upward through the inverted sediment bowl, through the screen and inlet check valve into the pump chamber. Upward movement of the diaphragm forces fuel from the pump chamber through the outlet check valve and the pump outlet. From the pump outlet the fuel passes through a fuel line to the carburetor.

b. The diaphragm is pulled downward by the lever arrangement, but is returned upward by the action of the spring. After the carburetor bowl becomes filled with fuel, the diaphragm returns upward only as permitted by the flow of fuel through the needle valve of the carburetor.

c. A hand lever permits operating the pump manually for the initial filling of the carburetor bowl after it has been drained or has run dry because of an empty fuel tank.

17. AIR CLEANER.

The air cleaner (fig. 15) cleans the air which enters the carburetor intake. Air enters near the top of the cleaner, passes down and over a pool of oil in the cup at the bottom. Some oil is carried up and deposited in the metallic filter element. Surplus oil which does not adhere to the filter element runs back into the cup. Dust and foreign particles in the air adhere to the oily surface of the element and are constantly washed back into the cup where they settle to the bottom. Cleaning the cup and filter and filling to the

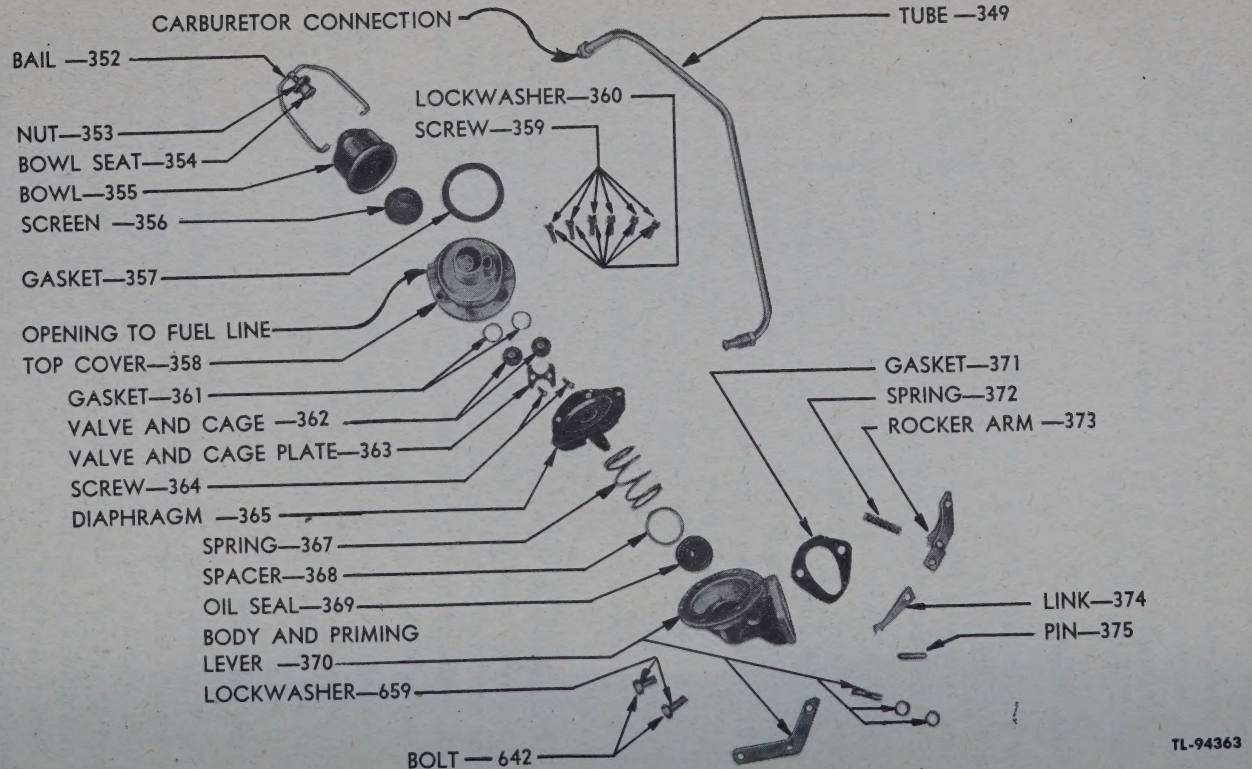

Figure 14. Fuel pump assembly.

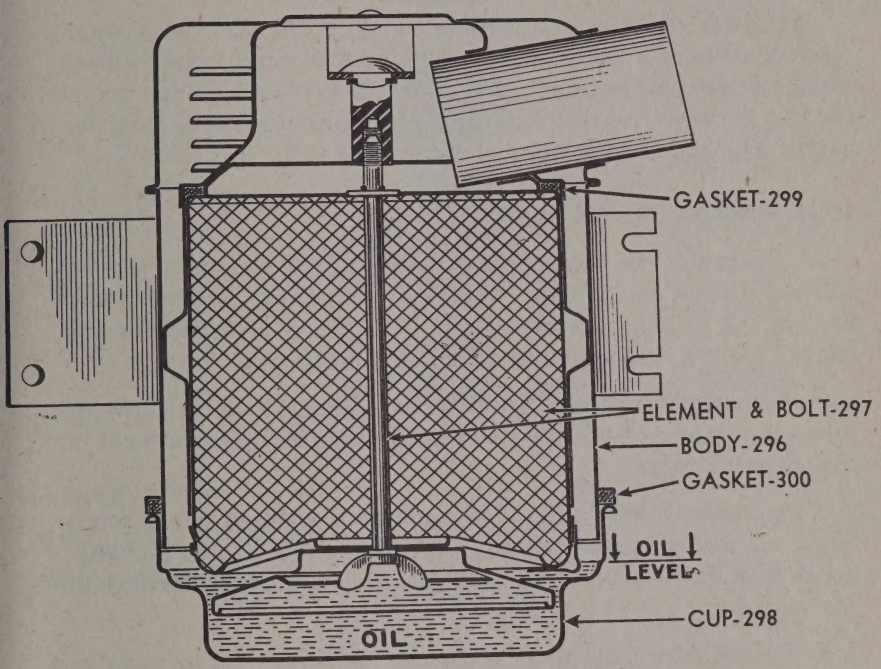

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Figure 15. Air cleaner.

proper level with clean oil when necessary, keeps the cleaner in good functioning condition.

18. SPARK PLUGS.

The spark plugs are important parts of the ignition system. Each consists of a center electrode highly insulated from the base which carries another electrode. The ignition spark jumps across the gap between the electrodes and it is quite important that this gap be kept adjusted at approximately .025 inch.

19. MAGNETO (figs. 16 and 17).

a. General. The magneto consists of a magnetic rotor (fig. 16 (220)), an ignition coil (fig. 17 (215)) with primary and secondary windings, a shunting capacitor (fig. 17 (208)), a distributor cap (fig. 17 (177)), and an impulse-coupling mechanism.

b. Primary Winding. An electrical voltage is induced in the primary winding of the coil as the coil cuts the magnetic field of the magnetic rotor.

c. Secondary Winding. The secondary winding has a much larger number of turns than the primary winding so that a changing current in the primary induces a much larger current change in the secondary.

d. Distributor Cap and Contacts. A distributor arm and distributor cap are added to the magneto to feed the high tension spark to the spark plugs. Four metal-insert contacts in the distributor cap are so placed that a spark occurs each time the rotating distributor arm passes one of the contacts. The distributor arm passes a contact point at the instant the primary is cutting the maximum number of magnetic lines of force, thus providing maximum spark intensity.

e. Capacitor. The capacitor discharges its energy back into the primary winding at the moment the spark occurs, causing a rapid collapse of the field built up around the primary. This produces a high voltage in the secondary winding which is impressed through one of the contacts in the distributor cap to the spark plug, causing it to fire.

f. Impulse Coupling. The impulse-coupling mechanism consists of a drive shaft (fig. 16 (232)) coupled to the magnetic rotor

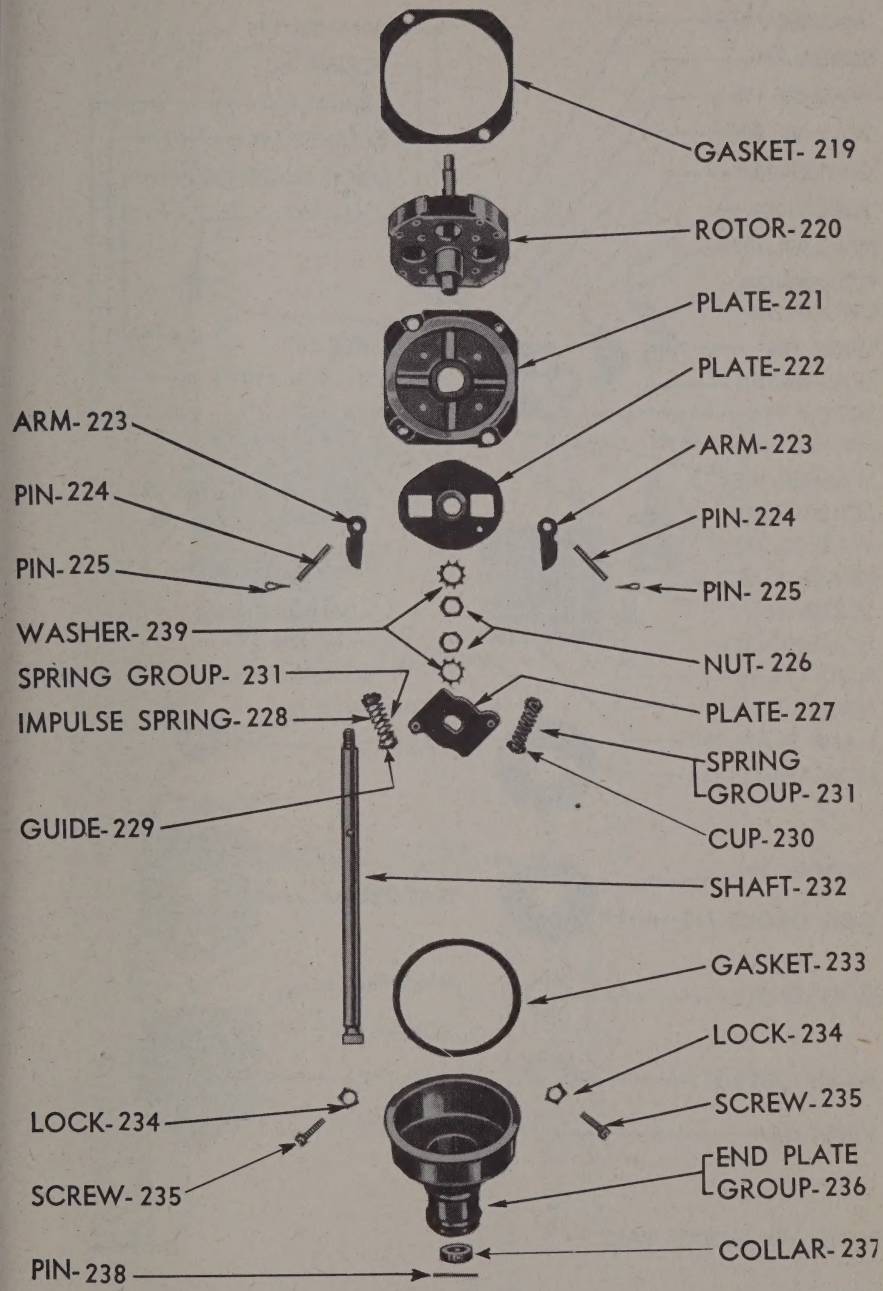

Figure 16. Magneto parts, drawing No. 1.

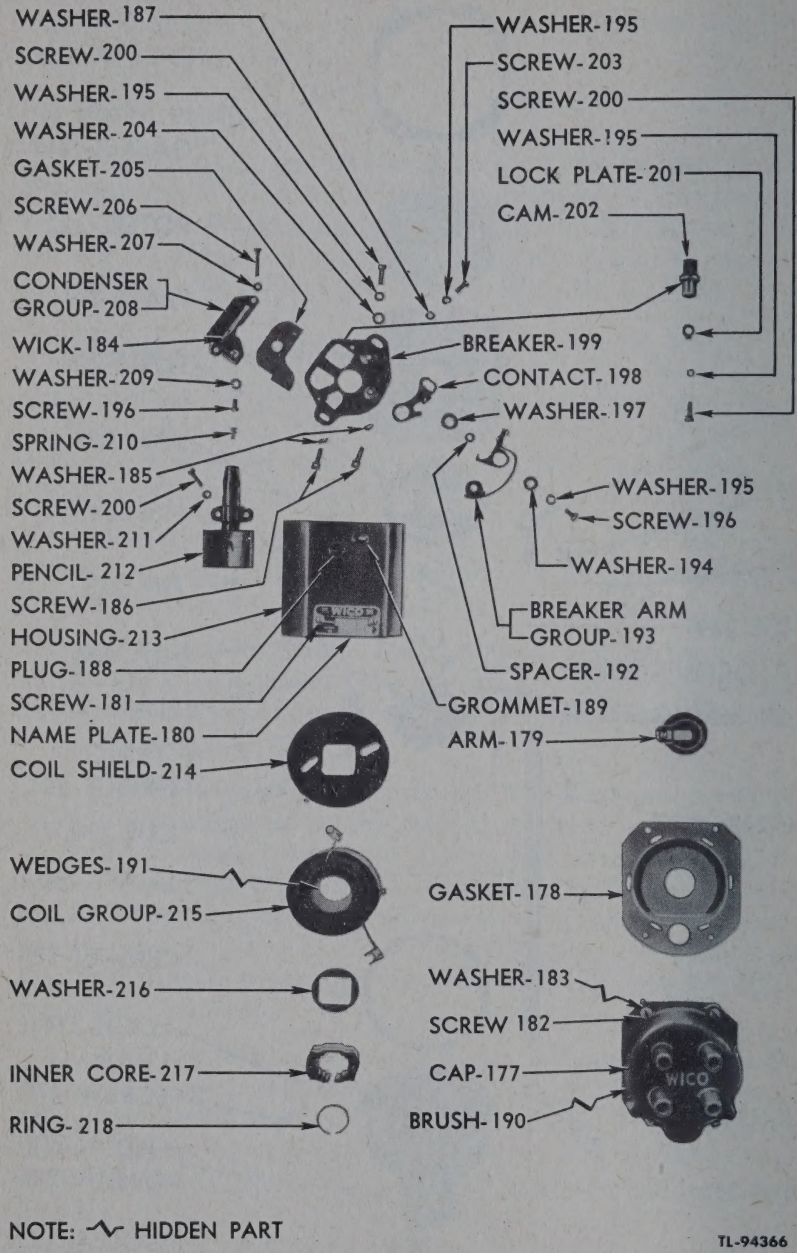

Figure 17. Magneto parts, drawing No. 2.

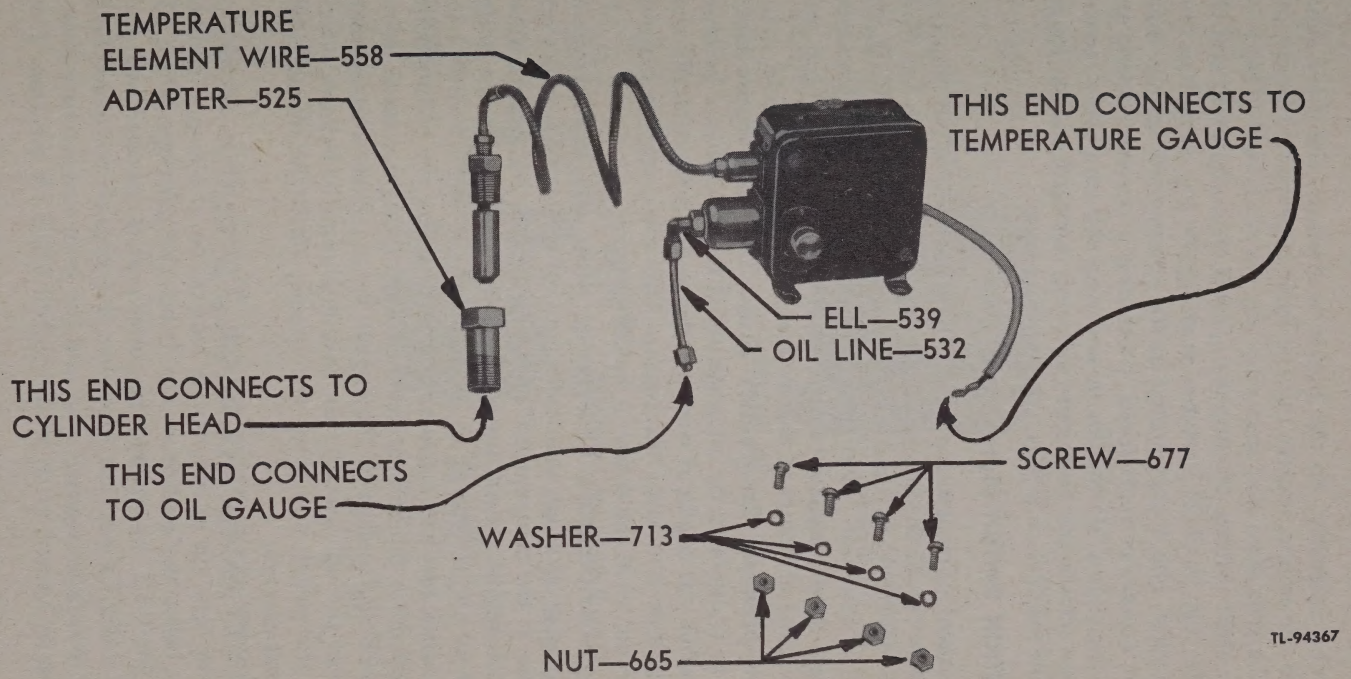

Figure 18. Ignition switch, showing exterior connections.

by a spring assembly. As the engine is cranked, the drive shaft, geared to the engine, rotates but the rotor is prevented from turning by the trip arms and stop pins (fig. 16 (223) and (224)). As the drive shaft rotates, the impulse springs are compressed and the cam plate (fig. 16 (222)) rotates, pushing the trip arms free from the stop pins. The energy stored in the compressed springs snaps the rotor around at high speed, producing a powerful spark and starting the engine. As the engine and magneto gain speed, centrifugal force causes the trip arms to swing outward and no longer engage the impulse stop pins.

20. IGNITION SWITCH (figs. 18 and 19).

a. General. The ignition switch is inclosed in a box which is mounted on top of the engine control panel. The switch has three positions; OFF, RUN, and ON. The engine is started with the switch in ON position. After the oil pressure builds up to 6 pounds, the switch automatically returns to RUN position. Three protective circuits are parts of this switch.

b. Low-pressure Emergency Stop. The low-pressure emergency stop is operated by oil pressure. If the oil pressure becomes too low while the engine is running, the switch automatically cuts off the ignition and stops the engine. This emergency stop is out of the circuit when the switch is in ON position.

c. High-temperature Emergency Stop. The high-temperature emergency stop automatically cuts off the ignition and stops the engine, if the temperature of the coolant in the engine water jacket rises higher than a predetermined point. This point is determined by the setting of an adjustment nut (fig. 19 (549)) inside the switch box and is preset at a point below the boiling point of the coolant. A temperature element containing a volatile liquid extends into the coolant in the engine water jacket. This element is connected through a small tube to a diaphragm or bellows, which operates the switch and stops the engine, when the pressure becomes great enough.

d. SAFETY-NO SAFETY Switch. This switch is electrically part of the ignition switch but is located on the engine control panel just below the ignition switch. It has two positions, SAFETY and NO SAFETY. Normally, the power unit is operated with this switch in SAFETY position. However, it is possible to bypass both the low pressure emergency stop and the high temperature emergency stop by throwing the switch to NO SAFETY position. This

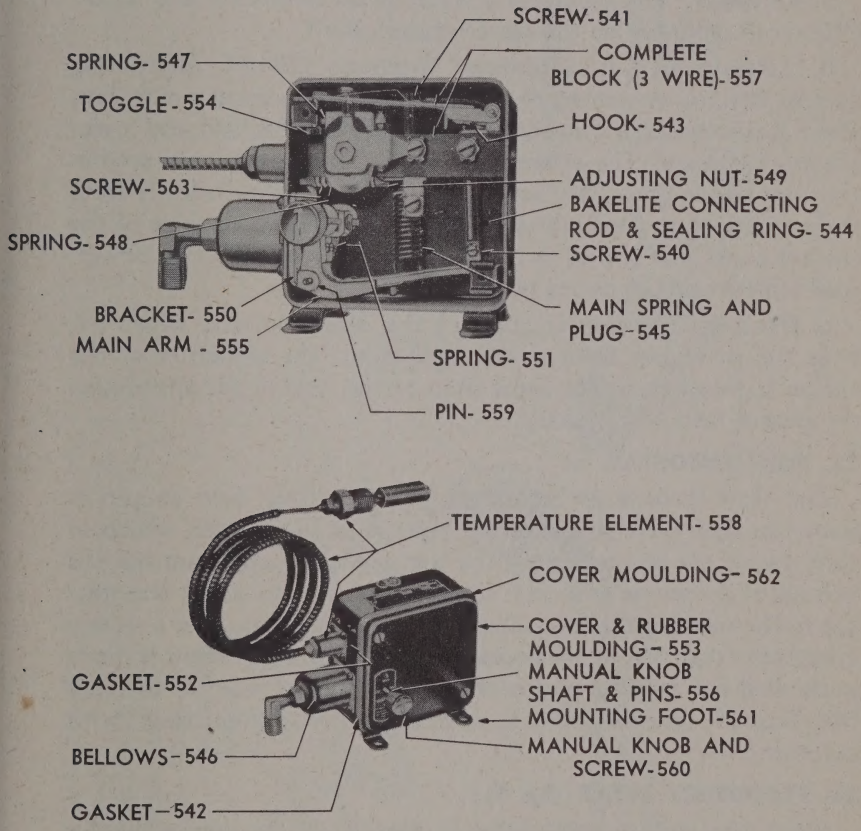

Figure 19. Ignition switch, showing parts.

should be done only if loss of power to the driven equipment would be more serious than possible damage to the power unit.

NOTE: Information on the functioning of carburetion and ignition systems will be found in the following technical manuals:
TM 10-550, Fuels and Carburetion
TM 10-580, Automotive Electricity

21. GENERATOR (fig. 20).

a. **General.** The generator consists of an alternator and an exciter, both mounted on the same rotating shaft.

b. **Alternator.** The alternator furnishes 120-volt alternating current for the operation of Signal Corps radio equipment. This alternator consists of two major parts, a revolving field and a stationary armature. The alternating current is actually generated in the two windings of the armature. There are direct leads from these windings to the Hubbell output receptacle on the side of the control panel box and to two convenience outlets and two power-stud outlets on the control panel.

c. **Exciter.** The exciter supplies the direct current which excites the revolving field of the alternator. The armature of the exciter is mounted on the same shaft as the field of the alternator; the exciter field is stationary.

22. FIELD RHEOSTAT.

The field rheostat is connected in the exciter field circuit as shown in figure 21. It varies the voltage of the exciter, which in turn varies the excitation of the a-c generator and controls the voltage of the entire unit. It is usually advisable to adjust the voltage to the rated or desired value after the machine reaches a steady operation condition at its normal load. If this adjustment is made in the first few minutes of operation it may be necessary to increase the rheostat setting slightly to compensate for normal rise in temperature.

23. FREQUENCY METER (fig. 3).

When the unit is started the frequency will be approximately 58.5 to 59 cycles per second. As the engine warms up, the engine speed will increase 30 to 45 rpm and the frequency will increase to the desired 60-cycle frequency. If no load is applied the frequency will rise even higher. As the frequency rises the voltage rises also. With no load the following readings may be expected: 115 volts at 58.5 cycles, 124 volts at 60 cycles, and 126 volts at 60.5 cycles. With the rated load of 5 kw, 118 volts at 59 cycles or 120 volts at 60 cycles may be expected.

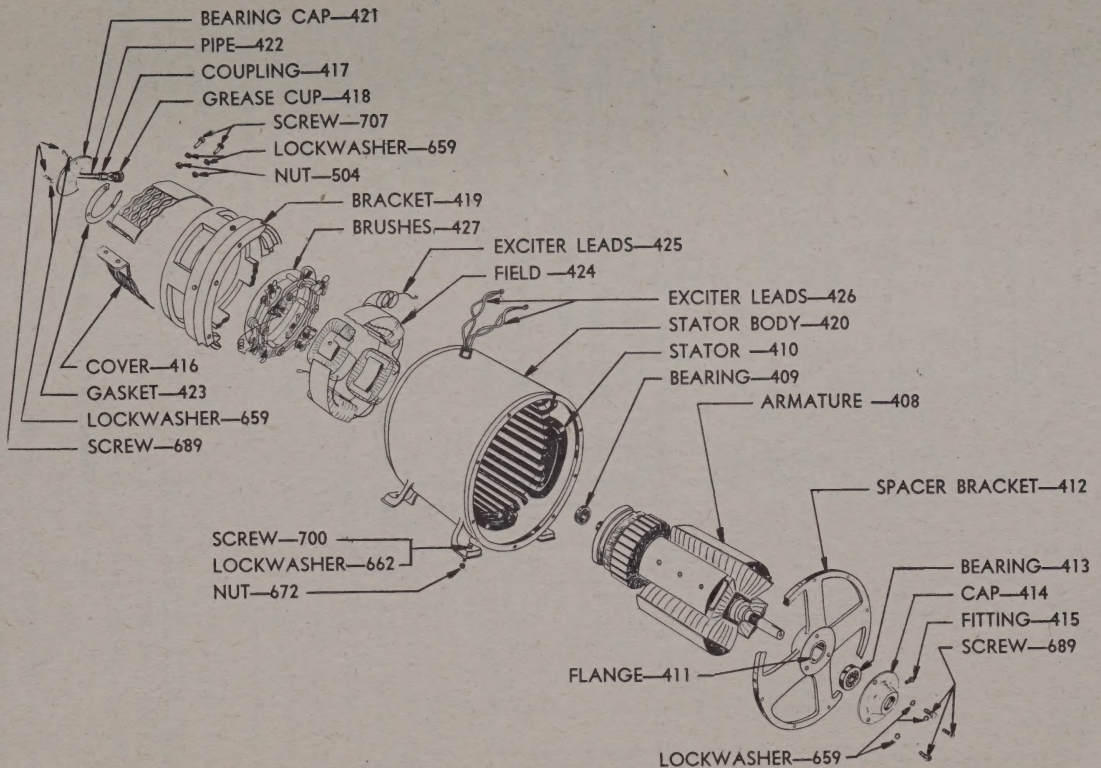

Figure 20. Generator assembly.

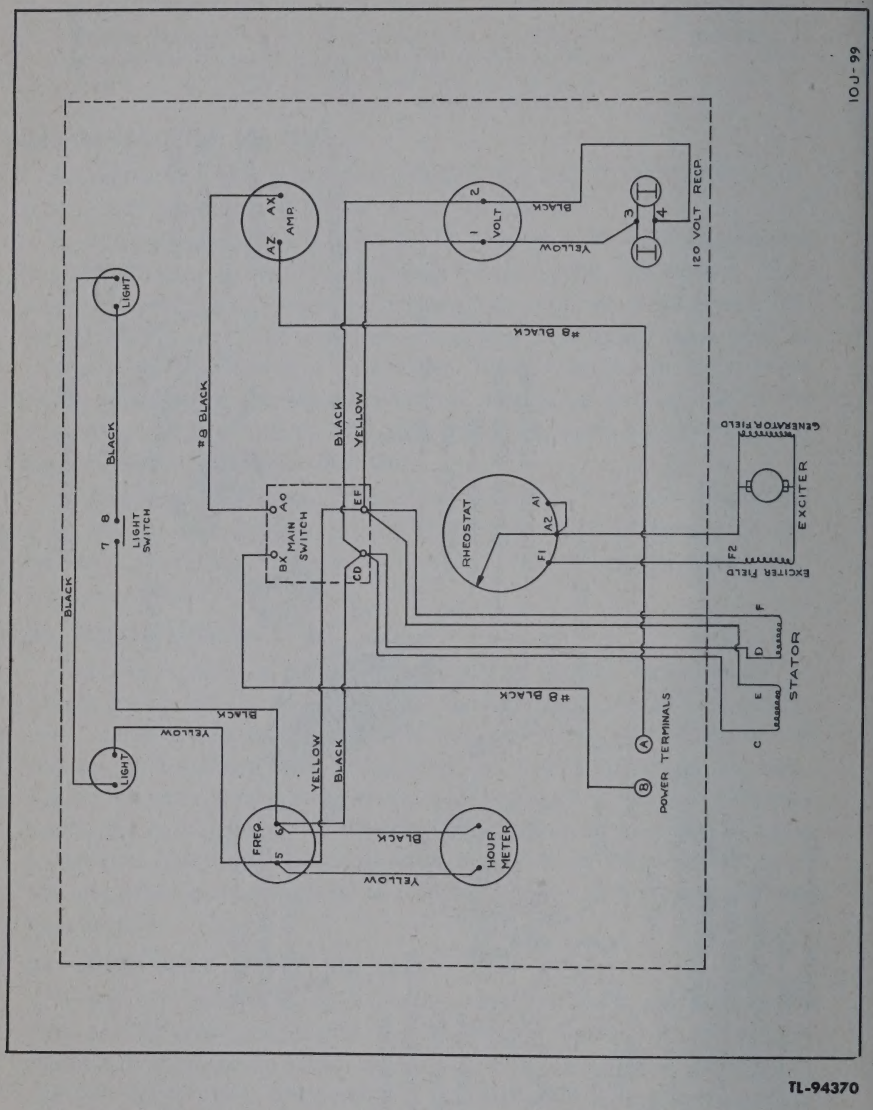

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Figure 21. Control panel wiring diagram.

SECTION IV
MAINTENANCE

NOTE: Failure or unsatisfactory performance of this equipment will be reported on W. D., A. G. O. Form No. 468. If this form is not available, see TM 38-250.

24. ROUTINE SERVICE.

a. General. Keep the unit clean and free from sand, dust, and water. Dirt, sand, or water in any part of the unit will cause trouble and serious damage. Keep the cooling air and water passages free from foreign matter, and keep the entire unit free from grease and dirt. In reassembling any part or parts of the unit, always be sure to replace all star washers, bonding, shielding, and capacitors. This is necessary in order to cut down possible interference with nearby radio equipment.

b. Daily or 8-hour Service Checks. (1) Open the hinged cover over the fuel gauge (fig. 22 (565)) and check the fuel supply. Keep the fuel tank full when the unit is shut down, and refill as often as necessary to maintain operation.

> CAUTION: Stop the unit while filling the fuel tank. Avoid spilling gasoline on the outside of the tank at all times.

(2) Check the level of the cooling liquid and replenish as necessary. Always allow enough air space so that the cooling liquid will not overflow when it becomes hot. In temperatures below 32° F, check the anti-freeze as needed, according to the table in paragraph 9. When operating in a hot climate, it may be necessary to check the radiator twice daily.

> CAUTION: Be careful when servicing the radiator, if the unit is hot. Sudden removal of the radiator cap releases a cloud of steam and a spray of hot water, which may scald bare hands or arms. Wear gauntleted asbestos gloves to avoid injury.

(3) Withdraw the bayonet-type oil gauge and check the oil level. The bayonet gauge is on the magneto side of the engine between the idler pulley, cylinder, and the starting motor. The rod is marked

FULL and EMPTY. Never allow the oil to drop below a level about half way between FULL and EMPTY. See paragraph 25, for recommended lubrication.

(4) Check the entire unit for loose screws, nuts, bolts, or fastenings of any kind, and tighten as needed. Wipe off any dirt, oil, or grease, and be sure that the radiator air passages are unobstructed.
(5) As soon as the unit is started, check all the meters and gauges on the control panel, and take any necessary steps to correct any faults that may be indicated.

c. Bi-weekly or 64-hour Check. See paragraph 25.

d. Monthly or 128-hour Check. (1) Make all the checks as instructed in paragraph 25 *b* (2).

(2) Remove, clean, adjust, and replace all spark plugs (par. 38). Adjust the point gaps to 0.025 inch. Discard all plugs that are not in good condition and replace with new ones.

(3) Check the magneto breaker points with a feeler gauge (par. 37 e) and adjust them to 0.015 inch. If the points appear burned or pitted, dress them with a fine-grit hone. Replace both points if one of them appears unserviceable. Adjustment must be made with the points open to their widest gap.

(4) Remove the valve cover plate on the side of the cylinder block and check the valve tappet clearance with a feeler gauge. The clearance should be 0.014 inch. Be sure that the tappets are at their lowest point when checking and that the engine is cold. If the clearance is less than 0.014 inch, adjust the tappets to this clearance. Recheck the clearance after tightening the locknut to be sure that it has not changed.

(5) Shut off the fuel supply, and remove and thoroughly clean the fuel strainer. Reassemble the strainer, after opening the fuel valve, to be sure that there is no leakage.

(6) Inspect the alternator and exciter. The commutator and slip rings should have a smooth, mahogany appearance and be free from burns and pits. Clean the commutator and slip rings, if necessary, according to the instructions in paragraph 55.

(7) Check the brushes for good commutator or slip ring contact, free fit in their holders, and uniform spring tension. If the brushes

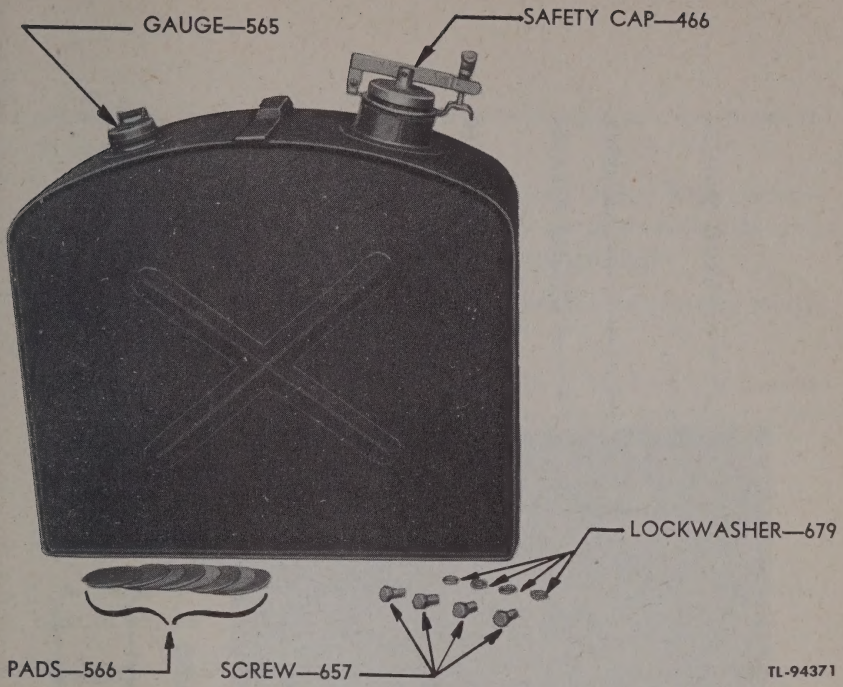

Figure 22. Gasoline tank assembly.

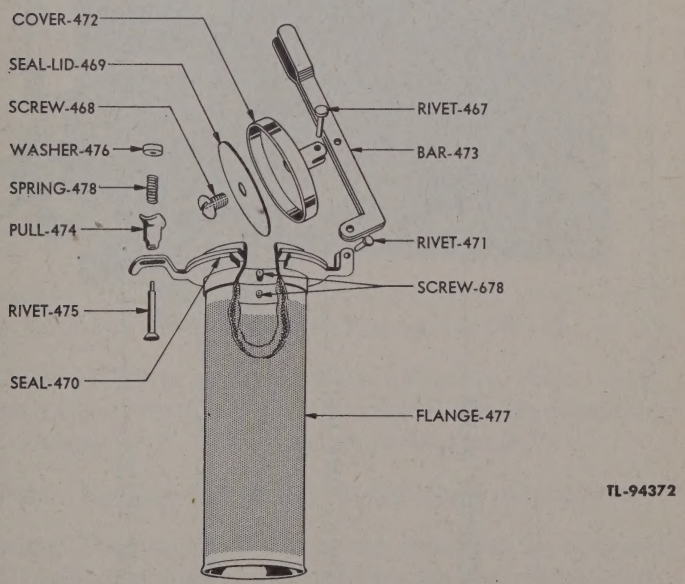

Figure 23. Gasoline tank safety-cap assembly.

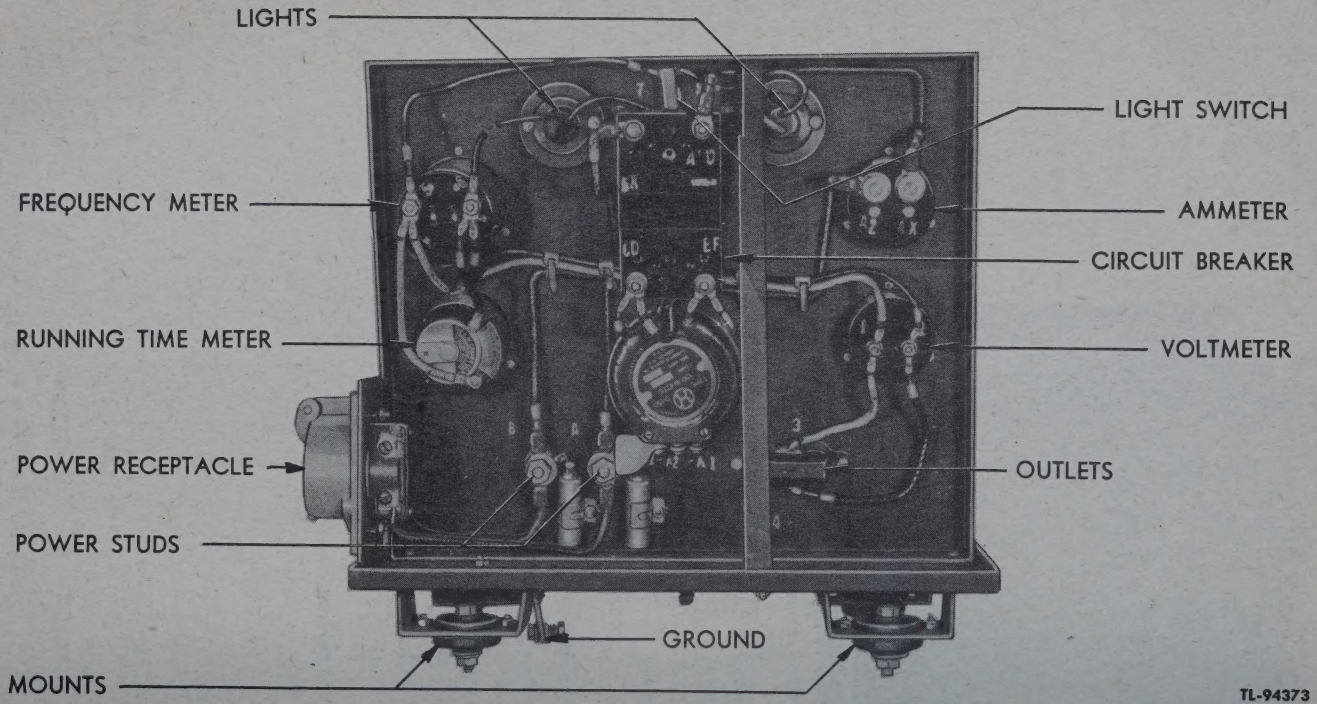

Figure 24. Control panel, rear view.

are worn to the extent that the brushholder fails to exert pressure on brushes, replace them.

(8) Check the cooling system for leaks and faulty hose connections. Drain the system and flush it out with clear water. Be sure that the drain cocks are closed, and refill the radiator.

(9) Inspect the commutator and the brushes of the starting motor and give them any attention indicated.

(10) Check all the connections and wiring in back of the control panel, and be sure that all connections are clean and secure. See figure 24.

25. LUBRICATION.

a. Nomenclature. The following list gives the standard nomenclature for the lubricants used in Power Unit PE-183-A:

Symbol	Standard Nomenclature	Specifications
OE 10	Oil, engine	U. S. Army 2-104B
OE 30	Oil, engine	U. S. Army 2-104B
PS	Oil, lubricating, preservative, special	U. S. Army 2-120
WB2	Grease, general purpose No. 2	U. S. Army 2-108
SD	Solvent, dry cleaning	Federal P-S-661a

b. Hourly Lubrication Maintenance. (1) EVERY 8 HOURS.

(*a*) *Air Cleaner.* Check the oil level and refill to the NORMAL level mark. Use the same grade of oil as used in the crankcase for temperatures above 0° F. Below this temperature use PS.

(*b*) *Crankcase.* Check the oil level on the bayonet gauge. Refill if necessary according to the schedule in paragraph 9b (1).

(2) EVERY 64 HOURS. (*a*) *Air Cleaner.* Remove, drain, clean, and refill with OE of the same grade as used in the crankcase for temperatures above 0° F. Below this temperature use PS.

(*b*) *Oil Filter.* Remove the drain plug and drain off the sludge.

(*c*) *Generator.* The front bearing of the generator is equipped with a Zerk fitting that may be reached through the cooling vents. Lubricate this bearing sparingly with WB2. Turn the grease cup

on the rear generator bearing one full turn and refill with WB2 when necessary.

(*d*) *Fuel Strainer.* Remove and clean the sediment bowl and screen. Open the fuel strainer shut-off valve to drain the water and sediment.

(*e*) *Crankcase.* Drain and refill with lubricant according to the table in paragraph 9 **b** (1). The crankcase should be drained only when the engine is hot. The capacity is approximately 5 quarts. After refilling, run the engine for a few minutes and recheck the level which should be at the FULL mark on the bayonet gauge. At the same time the pressure gauge will indicate if the oil is circulating.

(*f*) *Miscellaneous.* The following places should be oiled with OE: Tool box hinge and fastener, control panel box hinge and fastener, fuel cap hinge and lock, fuel tank gauge cover, and governor and throttle control linkage.

(3) EVERY 128 HOURS. Apply five or six drops of OE in the oil hole on the commutator end of the starter motor and also apply five or six drops of OE to the exposed portion of the front bearing.

(4) EVERY 256 HOURS. (*a*) *Oil Filter.* Drain and clean the inside of the filter body and renew the filter element. After the filter has been reassembled run the engine for a few minutes and check the oil level in the crankcase, filling if necessary.

(*b*) *Air Cleaner.* Remove the air cleaner and wash all parts with SD, or Diesel fuel oil. Refill the NORMAL mark with the correct lubricant according to the temperature.

> **CAUTION:** Use only SD, or Diesel fuel oil to clean greasy parts. AR 850-20 prohibits the use of leaded gasoline for cleaning purposes under any circumstances.

(5) EVERY 512 HOURS. Remove the plugs on the upper side of the magneto housing and lubricate the wicks with one or two drops of OE.

c. Cold Weather Operation. When the temperature is below 0° F use PS in every case except for the crankcase. At that temperature fill the crankcase with 75 percent OE 10 and 25 percent gasoline thoroughly mixed. The level should be checked more often

on the rear generator bearing one full turn and refill with WB2 when necessary.

(*d*) *Fuel Strainer.* Remove and clean the sediment bowl and screen. Open the fuel strainer shut-off valve to drain the water and sediment.

(*e*) *Crankcase.* Drain and refill with lubricant according to the table in paragraph 9 **b** (1). The crankcase should be drained only when the engine is hot. The capacity is approximately 5 quarts. After refilling, run the engine for a few minutes and recheck the level which should be at the FULL mark on the bayonet gauge. At the same time the pressure gauge will indicate if the oil is circulating.

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(*b*) *Air Cleaner.* Remove the air cleaner and wash all parts with SD, or Diesel fuel oil. Refill the NORMAL mark with the correct lubricant according to the temperature.

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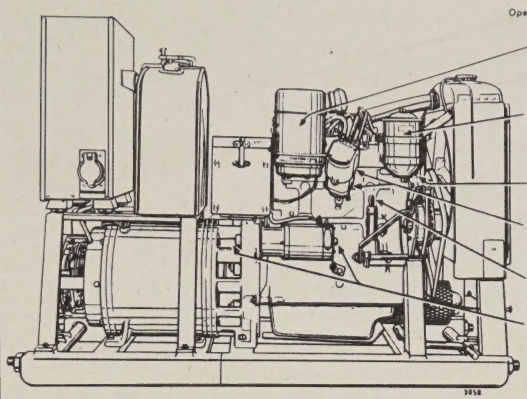
WAR DEPARTMENT LUBRICATION ORDER No. 3058

WAR DEPARTMENT, WASHINGTON 25, D. C., 6 MAY 1944

POWER UNITS PE-183 & PU-26



Operating Hours • Lubricant

8 OE *Air Cleaner*
Check level and refill to "NORMAL" level mark. Every 64 hours, remove, drain, clean and refill. Every 256 hours, remove and wash all parts.

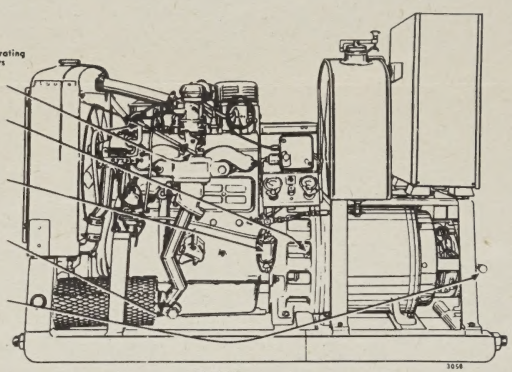
256 *Oil Filter*
Drain, clean inside of filter body and renew element. Refill crankcase, run engine a few minutes and add OE to FULL mark on gage.

64 *Oil Filter Drain*
Drain off sludge

512 OE Magneto Bearings
Remove plugs on upper side of housing, lubricate wicks with 1 or 2 drops, each.

8 OE Crankcase Fill and Level Gage
Check level (See Note)

128 OE Starting Motor Bearings
5 or 6 drops, each



Lubricant • Operating Hours

Governor and Throttle Control Linkage **OE 64**

Power Generator Front Bearing **WB 64**
Fitting reached through cooling vents. Lubricate sparingly

Fuel Strainer **64**
Remove and clean sediment bowl and screen. Also, open fuel strainer shut-off valve to drain water and sediment.

Crankcase Drain **64**
Drain and refill Cap. approx. 5 qt. (See Note)

Power Generator Rear Bearing **WB 64**
Turn grease cup 1 full turn. Refill cup when necessary.

KEY

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
OE—OIL, engine	above +32°F.	+32°F. to 0°F.	below 0°F.
Crankcase	**OE** SAE 30	**OE** SAE 10	See Cold Weather Note
Except Crankcase	**OE** SAE 30	**OE** SAE 10	**PS**
WB—GREASE, general purpose, No. 2. All air temperatures			
PS—OIL, lubricating, preservative, special			

COLD WEATHER—Below 0°F., drain crankcase. Refill crankcase with 3¾ qts. OE SAE 10 and mark this level "Normal" on the dip stick. This new level is below the indicated FULL mark. Add 1¼ qts. of gasoline and run engine five minutes. During operation and before shut-down add OE SAE 10 to "Normal" level. Before shut-down replenish to "Normal" level with OE SAE 10 and add gasoline to FULL mark on gage. Run engine five minutes to mix before stopping.

CRANKCASE—Drain only when hot. Refill to FULL mark on gage. Run engine a few minutes and recheck oil level. CAUTION: Be sure pressure gage indicates oil is circulating.

FITTINGS—Clean before applying lubricant.

HOURS—Reduce hours under severe operating conditions.

CLEAN parts with SOLVENT, dry-cleaning, or OIL, fuel, Diesel. Allow parts to dry thoroughly before lubricating.

OIL CAN POINTS—Every 64 hours, lubricate Tool Box Hinge and Fastener, Control Panel Box Hinge and Fastener, Fuel Tank Cap Hinge and Lock and Fuel Tank Gage Cover Hinge with OE.

DO NOT LUBRICATE—Water Pump Bearings, Engine Governor, Fan Idler Pulley.

LUBRICATED BY MAINTENANCE PERSONNEL—Crankcase Ventilator Baffle, Starting Motor Center Bearing and Bendix Drive, Magneto Breaker Cam Pad and Impulse.

REFERENCE—Technical Manual TM 11-937.

Copy of this Lubrication Order will remain with the equipment at all times. Instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 6 May 1944.

BY ORDER OF THE SECRETARY OF WAR:
G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

TL94044

Requisition LUBRICATION ORDER from Lexington Signal Depot, Lexington, Kentucky, or Holabird Signal Depot, Baltimore, Maryland, by Signal Corps Stock No. 6D10113-58.

No. 3058

Figure 25. War Department Lubrication Order.

TL-94044

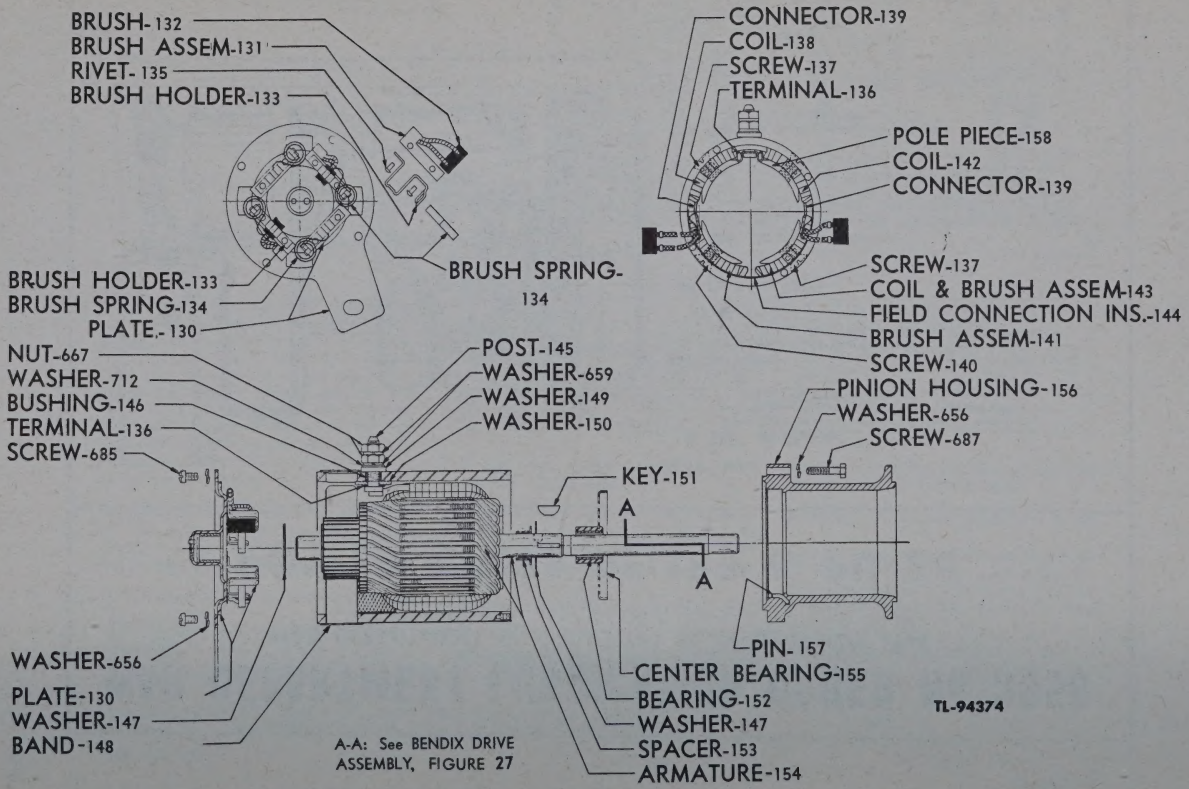


Figure 26. Starting motor assembly.

than when using OE 10 or OE 30. The level should be maintained at the FULL mark by adding gasoline only and the interval between draining should be reduced by one-half.

d. Lubrication by Repair Personnel. The following components should be lubricated during the overhaul period: (1) STARTING MOTOR. When the starting motor is disassembled for service, the intermediate or center bearing (fig. 26 (155)) should be lubricated with five or six drops of OE.

(2) BENDIX DRIVE. During maintenance apply OE sparingly to the Bendix drive assembly (fig. 27).

(3) CRANKCASE VENTILATOR BAFFLE. When repairs are being made, the bolt holding the crankcase ventilator pipe and baffle should be removed. Wash the ventilator pipe and baffle with SD. Dry and replace.

(4) MAGNETO. When repairs are being made on the magneto, apply two or three drops of OE to the breaker cam pad and the impulse mechanism.

> **NOTE:** Do not lubricate the fan idler pulley, engine governor or water pump bearings. The engine governor is lubricated by the engine lubricating system and the water pump and fan idler have sealed-for-life type bearings.

26. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. The operation of Signal Corps equipment in tropical areas where temperatures and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation: (1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

(2) Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths between connecting lugs, meter terminals, and switch terminals, causing flash-overs and damage to the equipment.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable

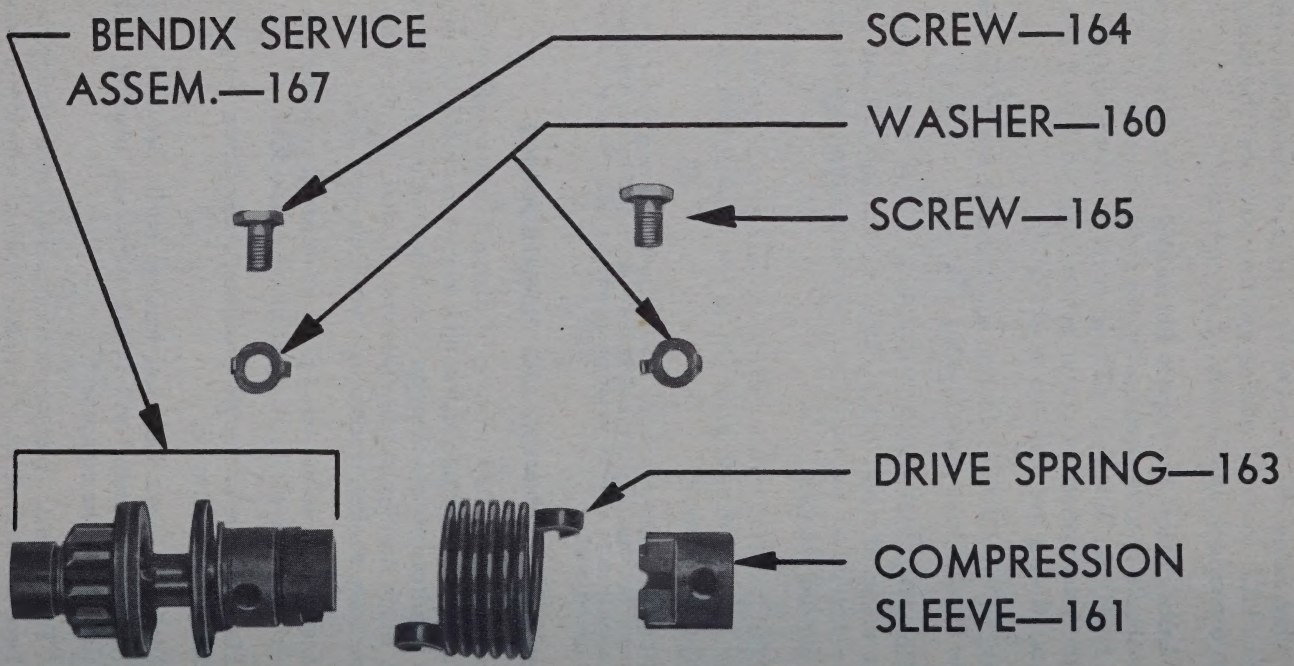


Figure 27. Bendix drive assembly.

degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing.

CAUTION: Varnish spray may have toxic effects if inhaled. To avoid inhaling varnish spray fumes, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-Step Instructions For Treating Power Unit PE-183-A. (1) PREPARATION. (*a*) Make all repairs and adjustments necessary for the proper operation of the equipment.

(*b*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(2) DISASSEMBLY. (*a*) Remove cap screw holding control panel box to top shock mount.

(*b*) Remove the five screws holding cover of control panel box.

(*c*) Remove the generator power leads from the circuit breaker terminals CD and EF (fig. 28).

(*d*) Remove the leads from the field RHEOSTAT (fig. 28).

(*e*) Disconnect the two leads from the terminals A and B (fig. 28) and the two leads from the power studs on the front of the panel (fig. 3).

(*f*) Remove the two bolts holding the panel to the base support.

(*g*) Remove the bolt holding the top of the panel to the top brace.

(*h*) Remove the entire panel for treatment.

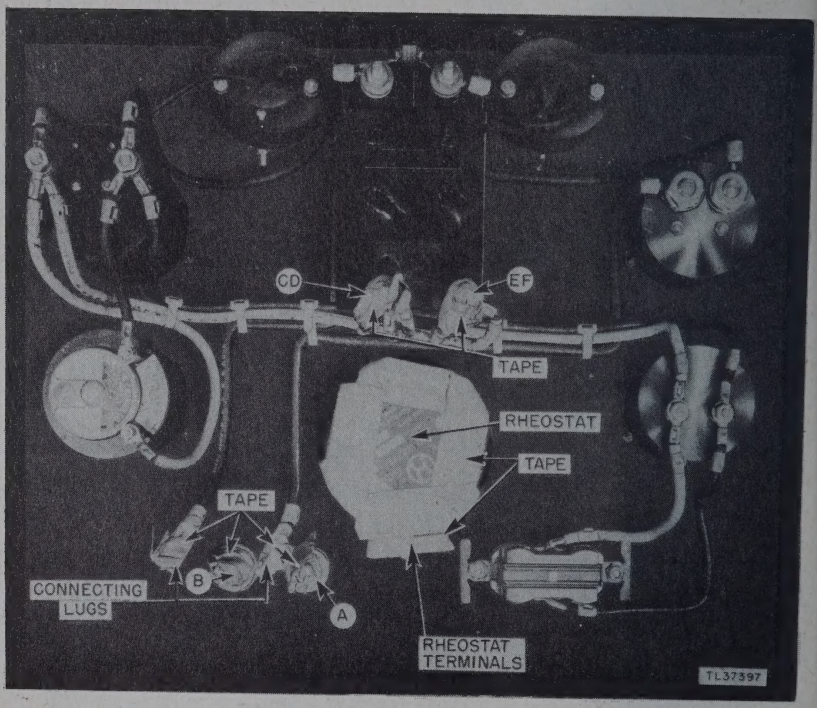
(3) MASKING. Mask the following with paper and masking tape.

(*a*) Mask the circuit breaker terminals CD and EF (fig. 28).

(*b*) Mask the connecting lugs on the pcwer leads to terminals A and B (fig. 28).

(*c*) Mask terminals A and B (fig. 28).

(*d*) Mask the bare wire portion of the field RHEOSTAT (fig. 28).



TL-37397

Figure 28. Back of control panel, masked.

(*e*) Mask the field RHEOSTAT terminals (fig. 28).

(4) DRYING. Dry the entire panel and panel components for 2 to 3 hours at 160° F.

(5) VARNISHING. (*a*) Apply three coats of Lacquer, Fungus-resistant, Spec No. 71-2202 (Stock No. 6G1005.3) or equal, with brush or spray gun to the panel components as covered in the following instructions.

(*b*) Hand brush the four meter cases that extend through the rear of the panel (fig. 3).

(*c*) Hand brush all joints on the meter cases making certain that the joints are completely sealed by the varnish.

(*d*) Hand brush the zero adjusting screws of the ammeter and voltmeter (fig. 3 (604 and 603)), after the meters have been properly zero adjusted.

(*e*) Seal the joint between the meter face glass and the front flange of each meter. The varnish should be applied lightly with a small hand brush making certain that the joint is well sealed, and that no air pockets are created by the hand brush in the application of the varnish.

(*f*) Spray the rear of the panel and all components mounted on it. (Do not spray the front of the panel.)

(6) REASSEMBLY. (*a*) Remove all masking tape and paper coverings.

(*b*) Clean all contacts with varnish remover. Burnish electrical connections and contacts if necessary to insure maximum electrical transfer.

(*c*) Reassemble the panel and test its operation.

NOTE: If the panel does not operate properly after reassembly, check all electrical connections for presence of varnish coating. Varnish coating on terminals and electrical contacts will act as an insulating material and prevent electrical transfer. Recheck the reassembly operation; component parts may have been improperly replaced, or power leads connected to the wrong terminals.

(7) MARKING. For reference purposes, mark "MFP" and date of treatment. Example: MFP-5 June 1944.

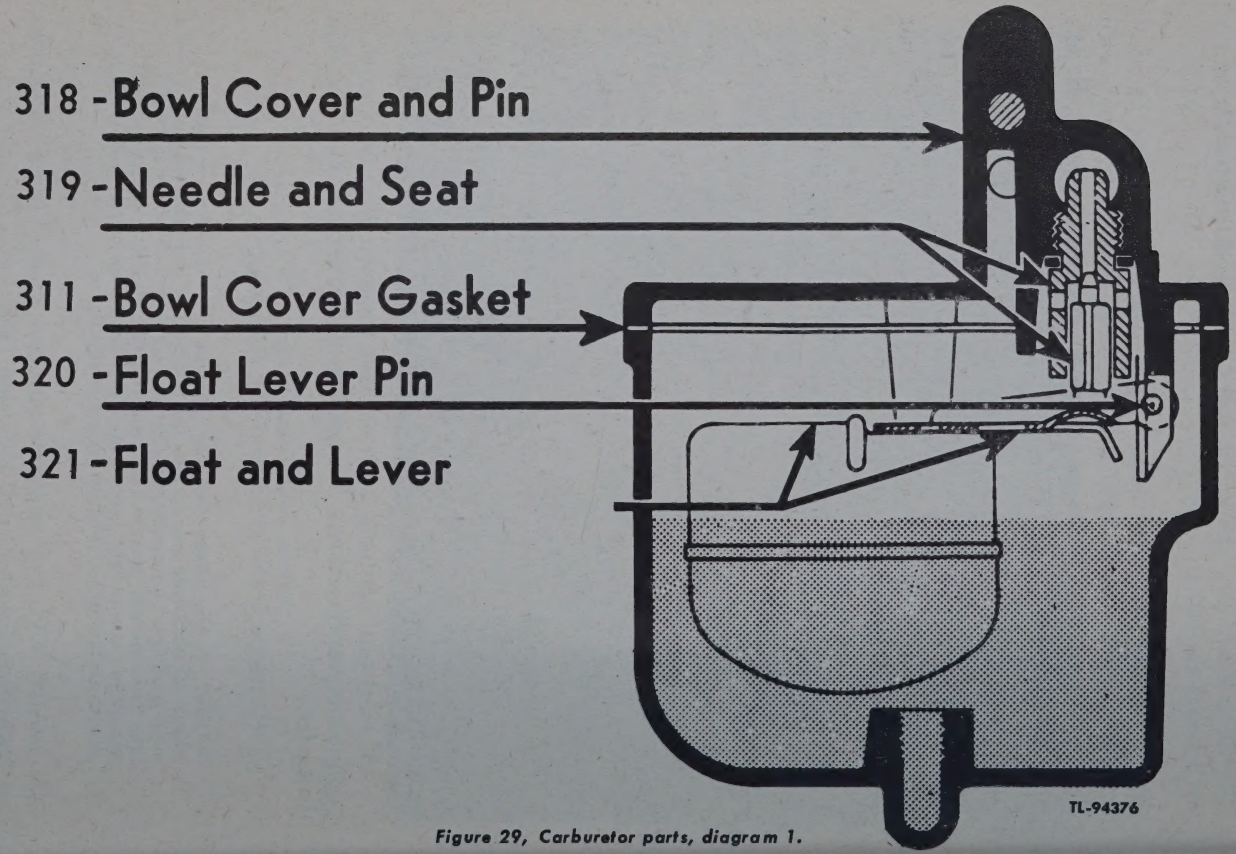


Figure 29, Carburetor parts, diagram 1.

27. FUEL.

a. Always make sure that the gasoline used is free from water and other foreign matter. Keep the air vent in the gasoline tank filler cap clear, as failure of air to enter the tank will prevent the flow of gasoline to the carburetor.

b. Except when the unit is to be out of use for prolonged periods, always fill the fuel tank after shutting down the unit. This will prevent condensation in cold climates, and the formation of gummy deposits which will result from the evaporation of gasoline in hot climates. If the unit is to remain idle for a period of several days, stop it by shutting off the gasoline supply instead of using the ignition switch, and drain the fuel tank. Remove, clean, and replace the fuel filter when the unit has stopped.

28. CARBURETOR ADJUSTMENTS.

a. General. As the speed of the unit is governor-controlled, the speed is normally maintained at 1,800 rpm and no idling speed adjustment should be needed. If, after checking spark plug gap, compression, breaker points, and valves (intake and exhaust), if it has been determined that trouble with the unit is due to faulty carburetion, make the following minor adjustments before completely disassembling the carburetor. (*Only experienced repair personnel should attempt to make these adjustments.*)

b. Carburetor Loads Up. If the carburetor loads up after considerable service, float level should be checked. Wear on lip of float lever (fig. 29) will raise float level. Float level may be reset by bending lip of float lever down to raise float level or bring lever up to lower float level. Only a slight bend is needed. See paragraph 30 **a** (2).

c. Motor Stalls While Idling. If the motor stalls while idling, reset throttle adjusting screw and idle adjusting screw (figs. 5 and 30) to specifications (par. 30 **b** (7)). If these adjustments do not correct the trouble: (1) Remove idle well plug and gasket assembly, allowing gasoline from the bowl to flush out idle well jet. Remove idle well jet (fig. 30 (314)) and blow out with compressed air.

(2) Remove low speed jet (fig. 30 (313)) and clean thoroughly with compressed air. Examine and see that jet seats gasoline-tight at shoulder. If not, replace with a new jet of identical specifications.

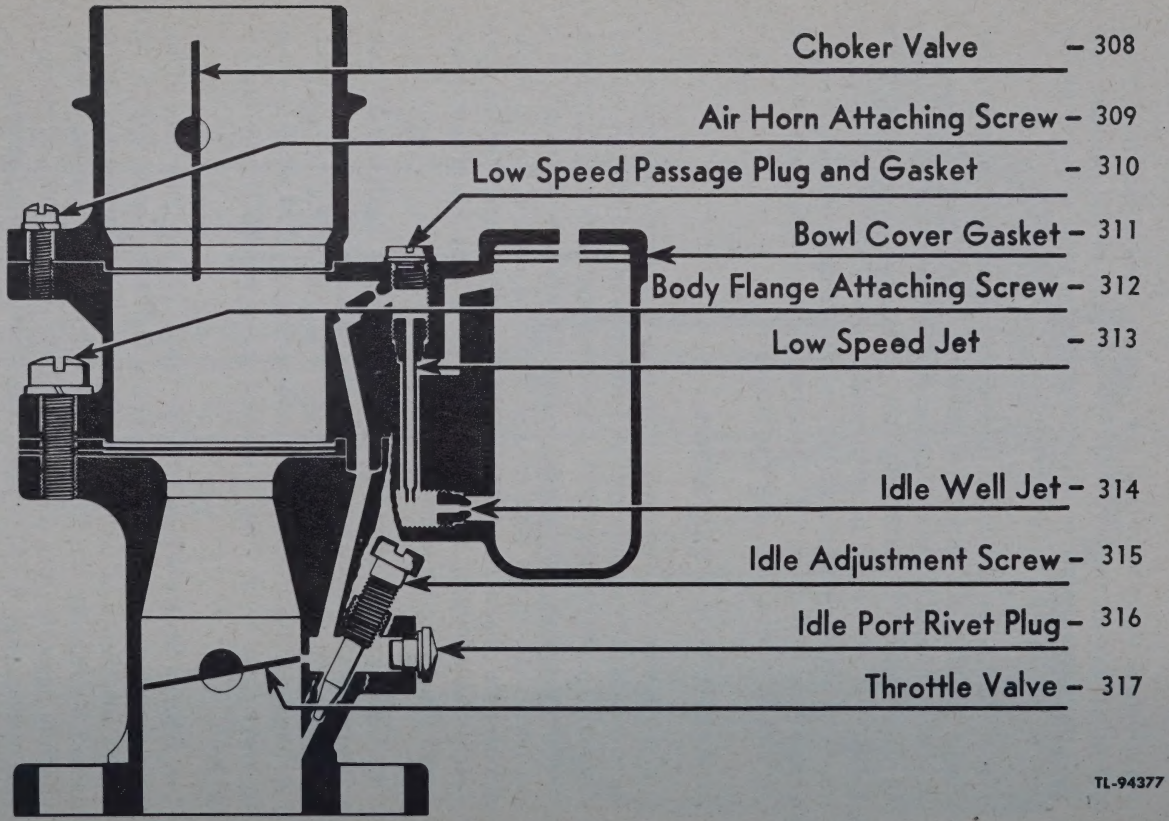


Figure 30. Carburetor parts, diagram 2.

(3) Examine bore of carburetor around throttle valve (fig. 30 (317)) for carbon accumulation.

d. Clogged Pump Jet. A clogged pump jet (fig. 31 (337)) should be removed and cleaned with compressed air, which in many cases, will remove the dirt or lint. It is usually advisable to replace the pump jet. All jets must be seated gasoline tight.

29. CARBURETOR DISASSEMBLY.

a. Carburetor Removal. See paragraph 31.

b. Steps of Disassembly. (1) Remove choke link pin spring, choke connector link and spring (fig. 12 (350)).

(2) Remove air horn assembly with all parts attached (fig. 12 (302)).

(3) Remove low speed jet plug and gasket assembly (fig. 30 (310)).

(4) Remove low speed jet (fig. 30 (313)).

(5) Remove idle well plug and gasket assembly.

(6) Remove idle well jet (fig. 30 (314)).

(7) Remove throttle shaft arm and screw assembly (fig. 31 (333)) and throttle connector rod.

(8) Remove bowl cover with all parts attached (fig. 29).

(9) Remove pump spring from cylinder in body (fig. 31 (342)).

(10) Remove idle adjusting screw and spring (fig. 30 (315)).

(11) Remove metering rod jet and gasket assembly (fig. 32 (331)).

(12) Remove nozzle passage plug and gasket assembly (fig. 32 (327)).

(13) Remove nozzle retainer plug (fig. 32 (328)).

(14) Remove nozzle and nozzle gasket (fig. 32 (329)).

(15) Remove body flange attaching screws (fig. 30 (312)) and then remove flange from body.

(16) Remove strainer passage plug and gasket assembly and strainer (fig. 31 (341)).

(17) Remove intake ball check assembly (fig. 31 (339))

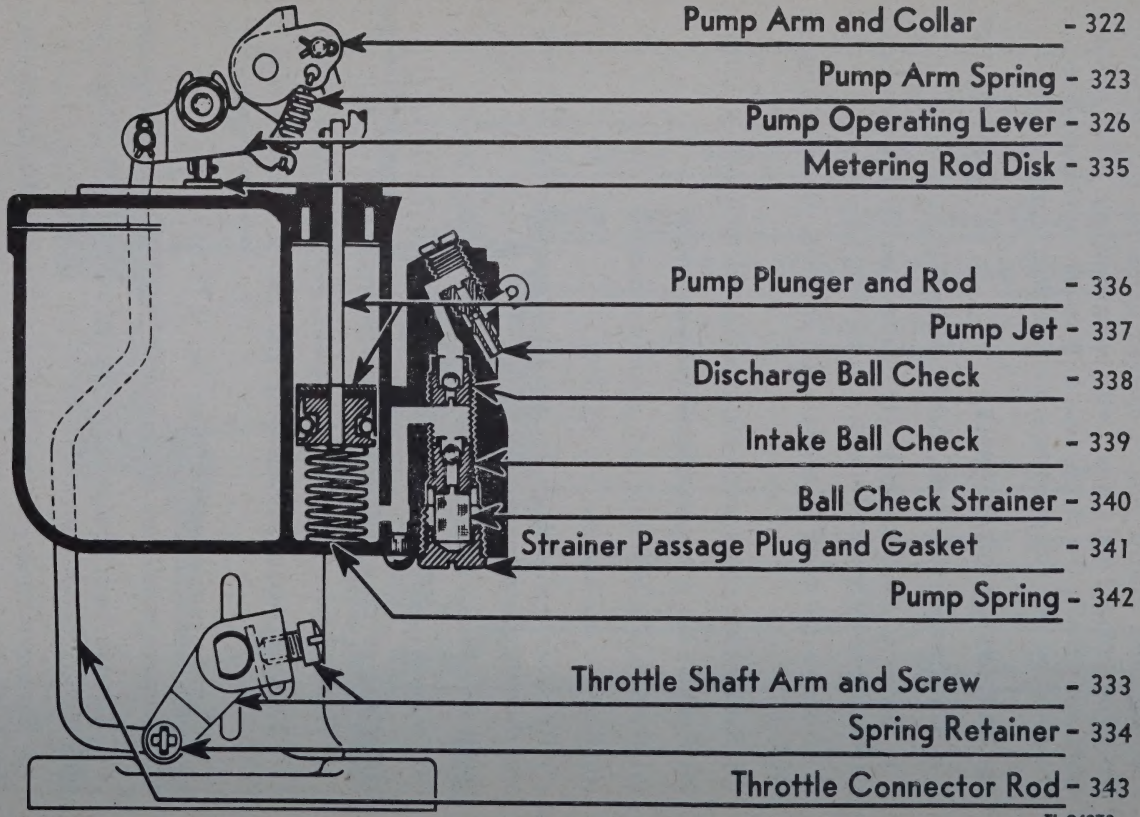


Figure 31. Carburetor parts, diagram 3.

(18) Remove discharge ball check assembly (fig. 31 (338)).

(19) Remove pump jet passage plug and gasket assembly.

(20) Remove pump jet (fig. 31 (337)).

(21) Remove throttle valve screws, choke valve, choker shaft, and lever assembly (figs. 30 and 31).

(22) Remove idle port rivet plug (fig. 30 (316)).

(23) Remove choke tube bracket assembly.

(24) Remove choke valve screws, choke valve and choker shaft and lever assembly.

(25) Disassemble all parts from bowl cover.

c. Cleaning and Grouping. (1) Clean all castings thoroughly inside and out with a small brush and SD. Blow all passages out with compressed air.

(2) Group all parts as follows:

Group A. Parts controlling the gasoline level.

Group B. Low speed circuit parts.

Group C. High speed circuit parts.

Group D. Pump Circuit parts.

Group E. Choke system parts.

(3) Examine each part in each group and replace those parts that show signs of wear or damage. Clean all parts with SD and blow off with compressed air. If any carbon is in the bore of the flange, remove it by scraping or with sandpaper (do not use emery cloth). Install all parts tightly.

30. CARBURETOR REASSEMBLY.

a. Group A Parts. (1) Install needle seat in bowl cover. Install bowl cover gasket. Then put pin and spring into needle and install float and lever assembly (fig. 29).

(2) Set float lever. Turn gasket around so gauge can be placed on machined surface of casting. Correct setting is $\frac{3}{8}$-inch. Do not depress float lip against spring in needle, but let float rest on its own weight. Gauge should then be placed between free end of float and

machine surface of bowl cover. Float should be set so it barely touches gauge. Adjustment is obtained by bending the lip on the float which contacts pin in needle. Do not bend on front of float in adjusting, as damage will result.

b. Group D Parts. (1) Install pump jet and pump jet plug and gasket assembly (fig. 31).

(2) Install discharge ball check assembly (fig. 31).

(3) Install intake ball check assembly (fig. 31).

(4) Install pump check strainer and strainer plug and gasket assembly (fig. 31).

(5) Install pump spring (fig. 31).

(6) Install pump plunger and rod assembly (fig. 31).

(7) Install throttle shaft and lever assembly (fig. 31), back out throttle lever adjusting screw, then install throttle valve and throttle valve screw (be sure trade-mark on valve is toward the idle port side of carburetor when viewed from manifold side). With valve screws loose, tap throttle valve lightly to centralize it in bore of carburetor. Hold valve in place with fingers and securely tighten screws. (New screws are recommended.)

(8) Install idle adjustment screw and idle adjustment screw spring (fig. 30).

(9) Install idle port rivet plug (fig. 30).

(10) Install insulator and new gaskets, then install body on flange. Tighten screws evenly and securely.

(11) Install idle well jet and idle well jet plug and gasket assembly (fig. 30).

(12) Install low speed jet (fig. 30). Work jet into seat by moving back and forth, then install low speed jet plug and gasket assembly.

c. Groups B and C Parts. (1) Install metering rod jet and gasket assembly (fig. 32).

(2) Install bowl cover as assembled, tightening screws down evenly and securely.

(3) Install pump arm and collar and pump operation lever assembly and spring on pin in bowl cover (fig. 32).

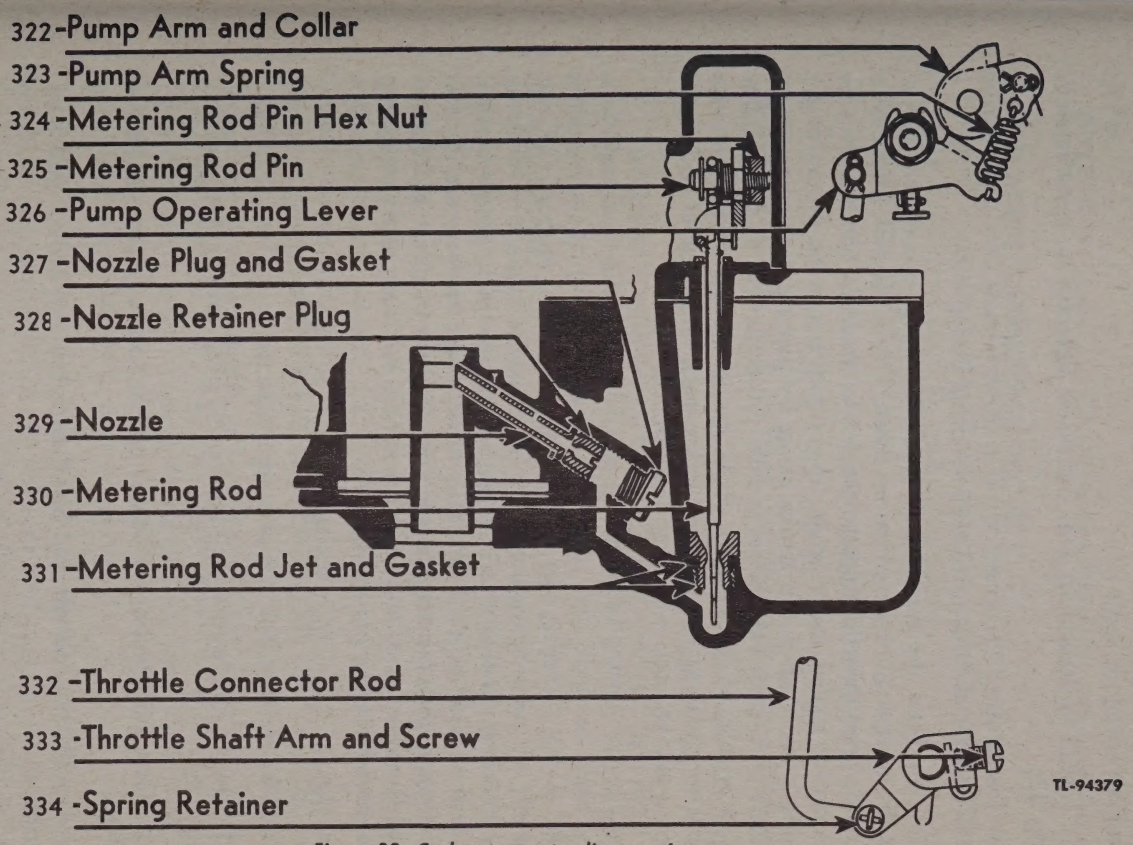


Figure 32. Carburetor parts, diagram 4.

(4) Install pump connector link (fig. 12), (ends away from bore and pin spring at top).

(5) Install throttle shaft arm and screw assembly on throttle shaft (fig. 32).

(6) Install throttle connector rod in throttle shaft arm, using spring and retainer at lower end and pin spring at top end.

(7) To adjust the pump, pull back the throttle lever set screw. With throttle valve seated, pump should travel $^{17}/_{64}$-inch from closed to wide open throttle. Adjustment can be made by bending throttle connector rod at lower angle. Pump travel can be measured by using a universal pump stroke gauge by placing base of gauge on raised portion of bowl cover so that projection ear of pump gauge rests on top of pump shaft. Hold gauge vertical. The difference between the number shown by index mark on gauge, at wide open and closed throttle positions, should be 17.

(8) Correct setting of metering rod (fig. 32 (330)) is important and must be made after pump adjustment. To adjust the metering rod, install metering pin and spring assembly, washer, and nut loosely on pump operating lever. Insert gauge in place of metering rod, seating tapered end in metering rod jet. Hold gauge vertical to insure seating. With throttle valve seated, push metering rod downward until pin rests on shoulder of notch in gauge and tighten nut. Remove gauge and install metering rod, disc, and pin spring. Connect metering rod spring.

(9) Install nozzle and nozzle gasket (fig. 32).

(10) Be sure that flat side of nozzle faces up.

(11) Install nozzle retainer plug, nozzle plug, and gasket assembly (fig. 32).

d. Group E Parts. (1) Install air horn on body (figs. 12 and 30 (309)).

(2) Install choker shaft and lever assembly and choker pull back spring.

(3) Install choker valve, choker valve screw, centralizing the valve in the air horn, then tighten valve screws.

(4) Install choke operating lever assembly and hook pull back spring in place.

(5) Install choke connector link, connector link spring, and pin spring.

NOTE: Depot repair personnel will perform disassembly and make all adjustments outlined above.

31. REPLACING CARBURETOR (fig. 12).

If trouble is experienced with the carburetor: (See paragraph 28). To replace the complete unit, proceed as follows:

a. Disconnect choke wire.

b. Disconnect the governor rod from the throttle arm.

c. Disconnect the fuel line leading to the fuel pump.

d. Remove the air filter coupling from the carburetor air intake.

e. Using a 9/16-inch open-end wrench, remove the two nuts that fasten the carburetor to the flange of the intake manifold.

f. Using a new gasket between the intake manifold and carburetor flanges, reinstall the carburetor by reversing the above procedure.

32. GOVERNOR.

a. Governor Adjustments (fig. 5). Make the rod adjustment first. There are three adjustments possible. The governor, as manufactured, is calibrated for the desired full load engine speed and regulation range specified. If finer adjustment, or a different speed and regulation is desired, the following adjustments may be made, but before making speed or regulation adjustments, be sure bumper spring is backed out of contact with operation fork (that is, extends at least 7/8-inch out of body): (1) SPEED ADJUSTMENT. To increase governed speed, turn adjusting screw clockwise (to the right). To decrease, turn the screw counter-clockwise (to the left): if possible, make adjustment with engine fully loaded. Be sure to tighten adjusting screw lock nut securely after completing adjustment, to prevent change due to vibration.

(2) REGULATION ADJUSTMENT. If regulation (that is, difference in engine speed between full load and no load) is too broad (flat) or too close (sharp), it can be regulated by adjustment of the spring eye bolt (fig. 33 (505)). Shortening (taking up the length of the eye bolt with the adjusting lock nuts) sharpens regulation; lengthening broadens (flattens) regulation. Be sure that the flattened part of the eye bolt lines up parallel to the slide spring and

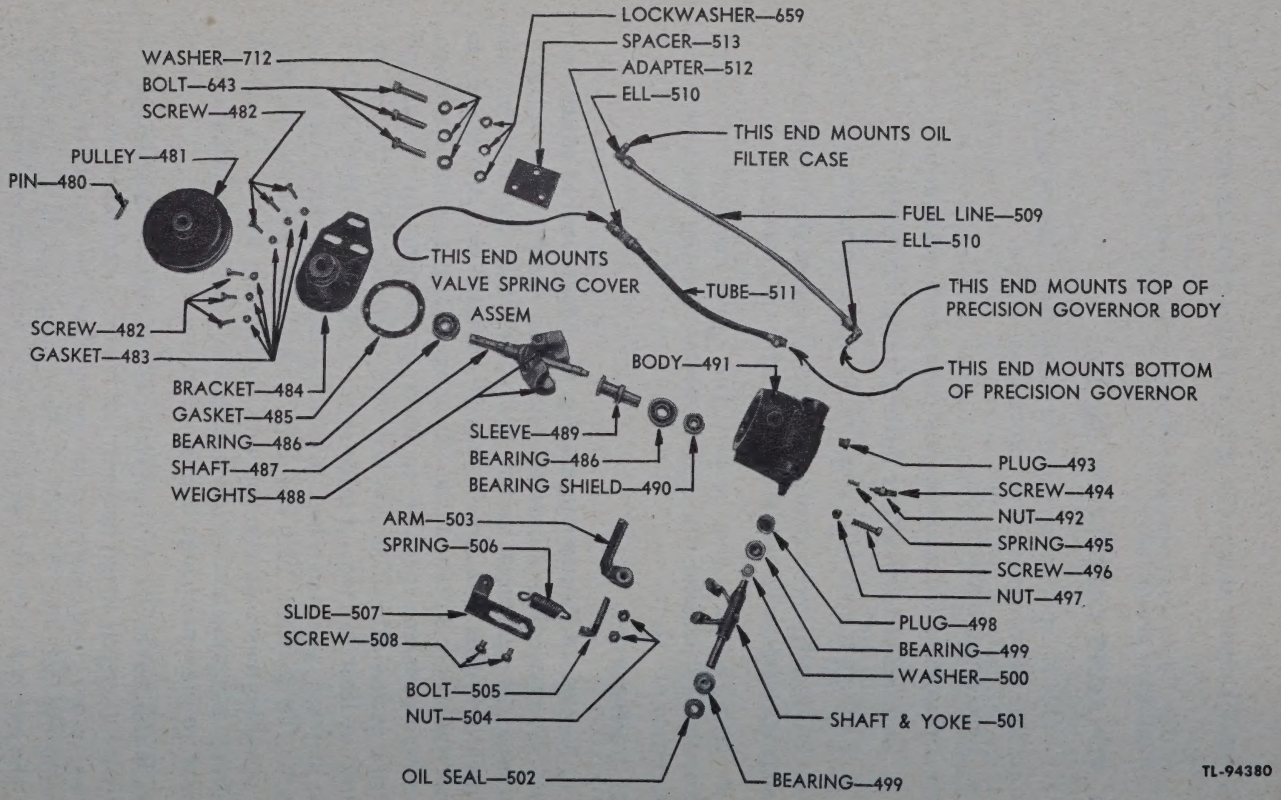


Figure 33. Governor assembly.

that both eye bolt lock nuts are tight. If this eye bolt adjustment is used, it may be necessary to reset the speed adjustment.

(3) SURGE CORRECTION ADJUSTMENT Surge (unstable governing, hunting) under full, or partial load should be corrected with the eye bolt regulation adjustment described above. Surge is the result of too sharp regulation. Surge, under no load, may be eliminated by use of the bumper spring. This adjustment is used *only* when surge is evident. With the engine surging at the governed no load speed, screw in the bumper spring screw carefully, a little at a time, until the surge is gradually eliminated. Do not screw it in any farther than is necessary to eliminate surge.

b. Specific Instructions. If it is necessary, for any reason, to disassemble the governor spring, spring slide, adjusting screw, or spring eye bolt, the following calibration dimensions must be carefully reset: (1) EYE BOLT SETTING. (from center of operation shaft—shaft on which governor lever is assembled—to center of eye bolt hole) $1\frac{3}{32}$ inch.

(2) SPRING SETTING, (measured from inside of spring loops) $2\frac{29}{32}$ inch. In assembling the governor spring, the painted end must be in the spring slide, not in the eye bolt.

c. To Check Governor Operation. (1) The voltage of a generator depends upon speed, as well as upon field strength, keep that in mind when changing speed adjustment. At no load, the cycles are approximately 61, and at full load approximately 60.

(2) To determine engine speed, check the frequency meter. Sixty cycles is the equivalent of 1,800 rpm. Each cycle represents 30 rpm.

(3) Surging, or uneven engine operation without the load change, is often caused by a lean mixture in the carburetor, or by dirt or water in the carburetor. Be sure that this is not the cause before working on the governor.

(4) To check for governor fault, touch the governor arm near the end of its travel, while surging. If the surging stops, and the governor operates smoothly, the fault is probably in the governor adjustment. If surging occurs at light loads, the anti-surge screw (fig. 5 (4)) should be screwed in until it touches a lever inside and damps the governor movement. Do not turn the screw in so far that it speeds up the unit. Be sure to tighten the lock nut.

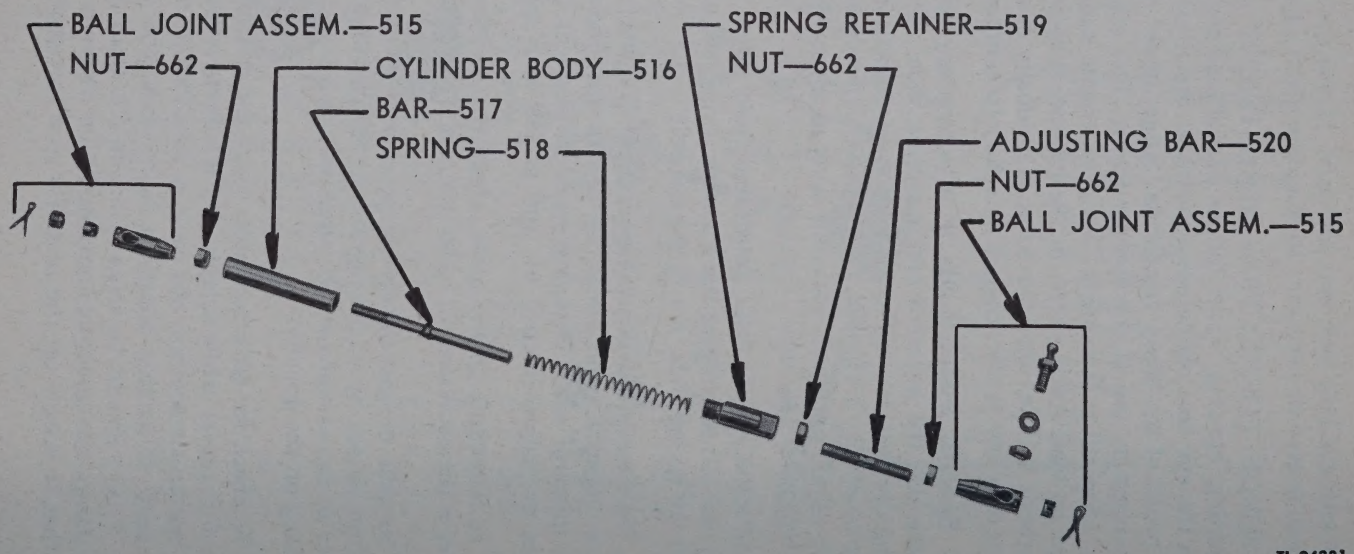


Figure 34. Throttle-rod assembly.

(5) If surging occurs under half to full-load conditions, it will be necessary to lengthen the adjusting screw (fig. 5 (2)) by screwing it out a few turns. Tighten the lock nut and readjust the speed by screwing out the adjusting screw (fig. 5 (1)) to obtain correct spring tension. Close speed regulation from no load to full load is obtained by having the screw (fig. 5 (2)) as short as possible without causing surging.

(6) The linkage, or rod, connecting the governor arm to the throttle arm must be of the correct length and the throttle arm must be set so that it is in the middle of its travel, thus giving free movement from an open to a closed position. Also the throttle and joints of the rod must be absolutely free during the full travel of the parts. The rods are adjustable as to length and must be set so that with the unit at rest, and with the governor and throttle in their normal wide open positions, the connections will hold the throttle arm about $\frac{1}{64}$-inch away from its wide open position. There is some tension on the governor spring when the unit is at rest.

33. AIR CLEANER.

a. The air cleaner on the carburetor air intake must be serviced at least once a week, or daily when operating in very dusty locations.

b. Remove the cup at the bottom of the cleaner (fig. 15). Empty the bowl and refill it to the indicated level with the same oil as used in the crankcase. Do not use oil that has been diluted with gasoline, but use the lightest undiluted engine oil available.

c. At least once each month, or weekly, if operating in very dusty locations, remove the entire air cleaner unit and wash it thoroughly in Diesel oil or SD. To remove the air cleaner, proceed as follows: (1) Loosen the two wire clamps located on opposite sides of the cleaner, and remove the bowl.

(2) Turn wing-nut at bottom of cleaner counter-clockwise until loosened sufficiently.

(3) Slide the air cleaner assembly out of the air cleaner housing.

(4) Disassemble the unit and thoroughly wash all parts in Diesel oil or SD.

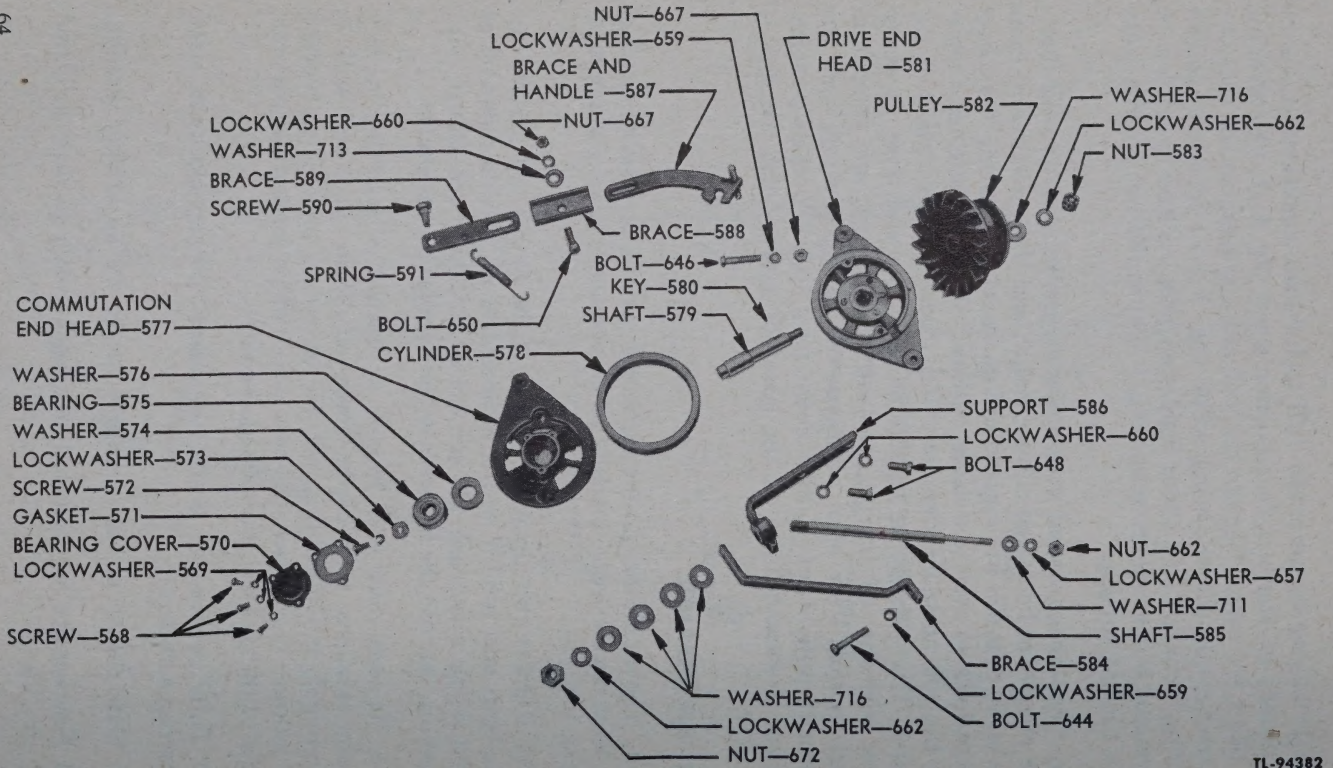


Figure 35. Idler assembly.

(5) Reassemble the unit and replace it on the engine. Be sure that all connections are tight to prevent the entrance of dust. Replace any gaskets that appear to be in poor condition.

(6) Do not forget to refill the oil reservoir to required level before replacing it on the unit.

34. FUEL STRAINER (fig. 37).

a. Inspect the fuel strainer daily to see if any dirt or water has collected in the glass bowl. If there is foreign matter present, close the fuel valve and remove the bowl by loosening the thumbwheel at the top of the strainer. Wipe the bowl thoroughly, both inside and out, with a cloth dampened with Diesel oil or SD. Reassemble the strainer. Open the fuel valve, and check for leakage at the top of the glass bowl. If there is leakage, tighten the thumb screw; if leakage continues, replace the cork gasket.

b. If necessary, remove and replace the fuel strainer as follows:

(1) Close the fuel valve.

(2) Remove the gasoline pipe from the strainer body.

(3) Remove the glass bowl and clamp.

(4) Unscrew the strainer body from the carburetor fuel intake.

(5) Blow out all passages and the strainer with a tire pump or compressed air.

(6) Reassemble in the reverse order of disassembly.

35. OIL FILTER.

a. The oil filter must be serviced at least every 256 hours, or more often if the condition of the drained crankcase oil indicates the need. Servicing may be necessary more often when operating under very low temperature conditions.

b. To service the oil filter, proceed as follows: (1) Using a 7/16-inch open-end wrench, or crescent wrench, remove the oil inlet bushing and using a 3/8-inch open-end wrench remove the oil outlet elbow.

(2) Remove the screws that hold the oil filter to its mounting bracket (fig. 38).

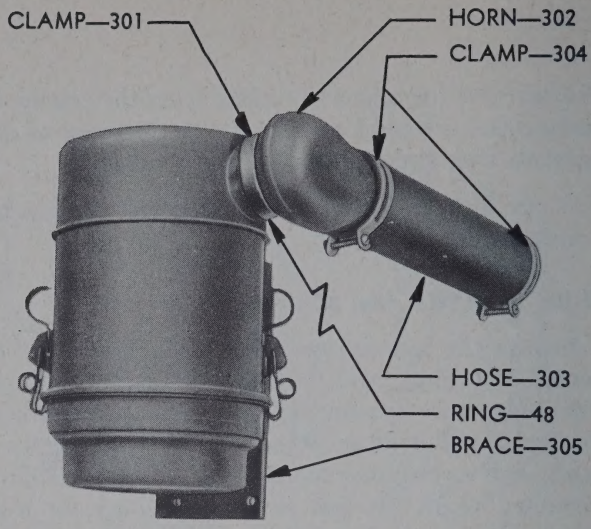


Figure 36. Air cleaner assembly and attaching parts.

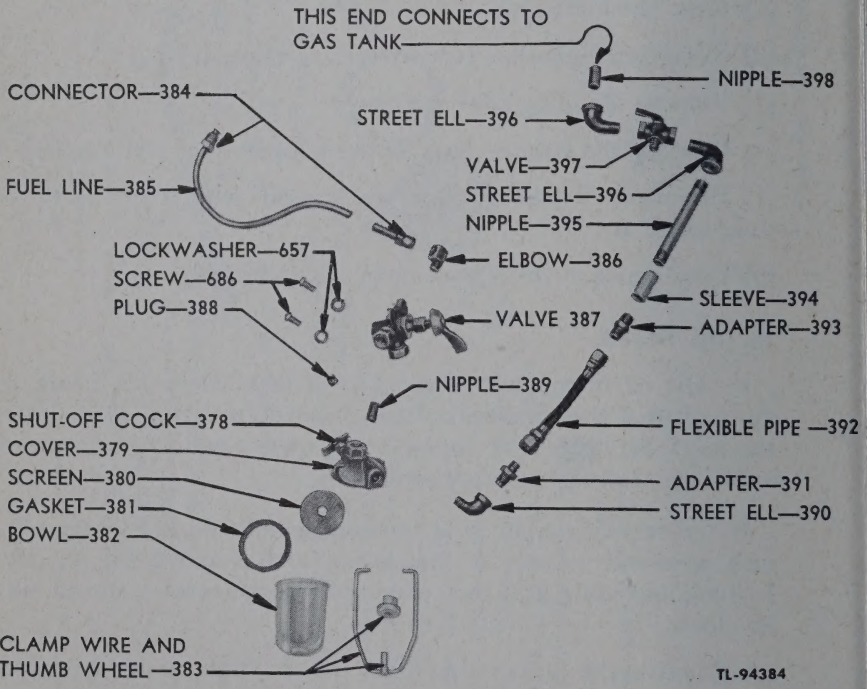


Figure 37. Fuel strainer assembly and connecting parts.

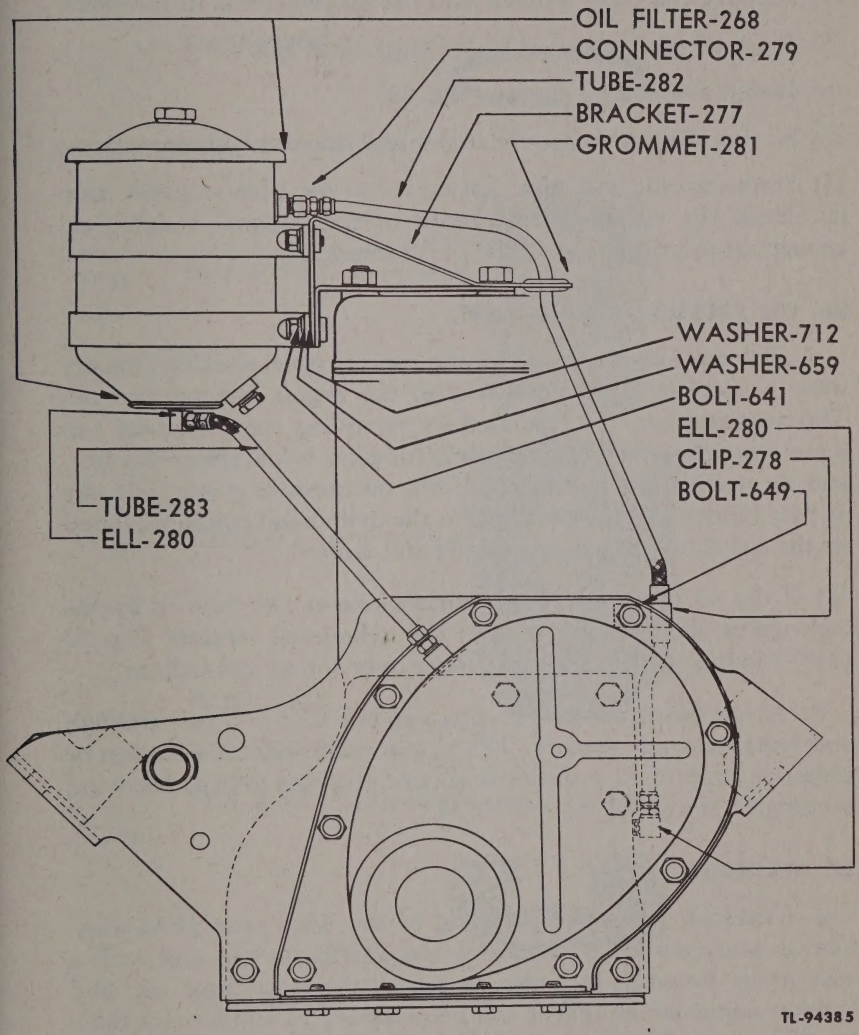


Figure 38. Oil filter connections and mounting parts.

(3) Using a crescent wrench, or a 1-inch wrench, remove the oil filter cover (fig. 39).

(4) Remove the filter element and the oil remaining in the filter.

(5) Wash all parts thoroughly in Diesel oil or SD.

(6) Install a new filter element (fig. 39).

(7) Reassemble the unit to the engine and reconnect all connections.

(8) Start the unit and, after letting it run for a few minutes, stop it. Check the oil supply by means of the bayonet gauge. Add enough oil to bring it up to the FULL mark.

36. OIL PRESSURE ADJUSTMENT.

a. The oil pressure gauge on the control panel should normally show a pressure of 15 pounds after the engine has warmed up. This pressure may be regulated by removing the Hex head cap screw from the side of the oil pump, directly below the carburetor, and proceeding as follows: (1) If the oil pressure is low, add one or two $\frac{3}{8}$-inch by $\frac{1}{32}$-inch shims in the cylindrical container found on the cap screw. Place over spring and tighten.

(2) If the oil pressure is high, remove one or two $\frac{3}{8}$-inch by $\frac{1}{32}$-inch shims (fig. 52 (252)) from the cylindrical retainer (fig. 52 (250)) found on the cap screw. Place over spring and tighten.

b. As the bearings become worn, additional oil will pass through and reduce the oil pressure. This is a normal drop. If a sudden or excessive drop in oil pressure is noticed stop the unit at once and investigate the cause.

37. MAGNETO.

a. General. The radio-shielding of the Wico type JEM magneto is accomplished by enclosing the distributor cap unit with a cast metal housing. In order to get at the distributor cap and breaker points of the unit it will be necessary to remove this radio shielding.

b. Removal of Radio Shielding. Remove the terminal shield cover screws (fig. 40 (174)) which will allow the terminal shield to be free of the unit. Take out the four distributor shield cover screws and lift off the distributor shield cover (fig. 40 (172)). This

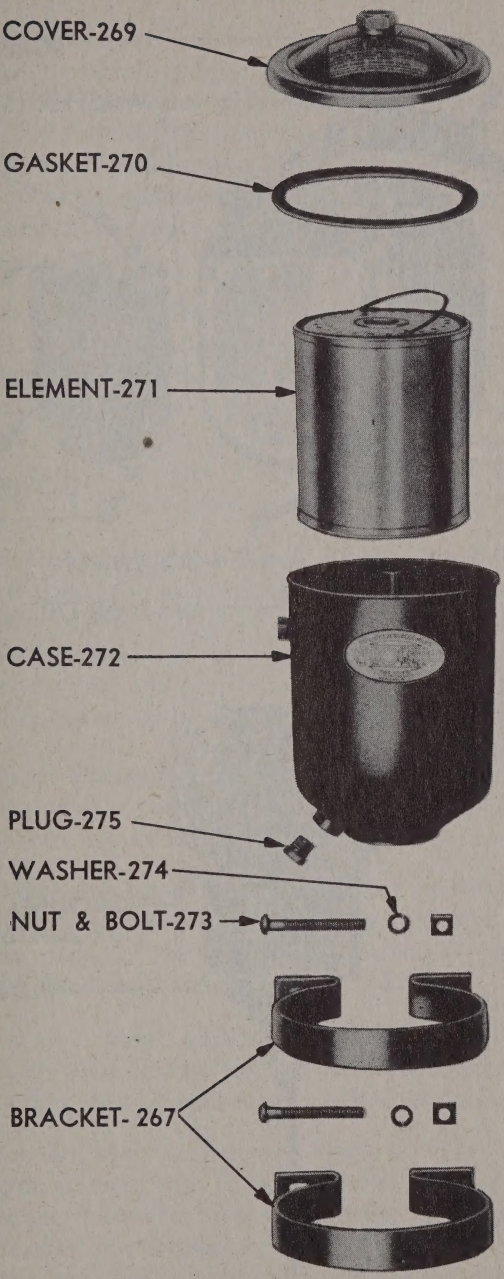


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Figure 39. Oil filter.

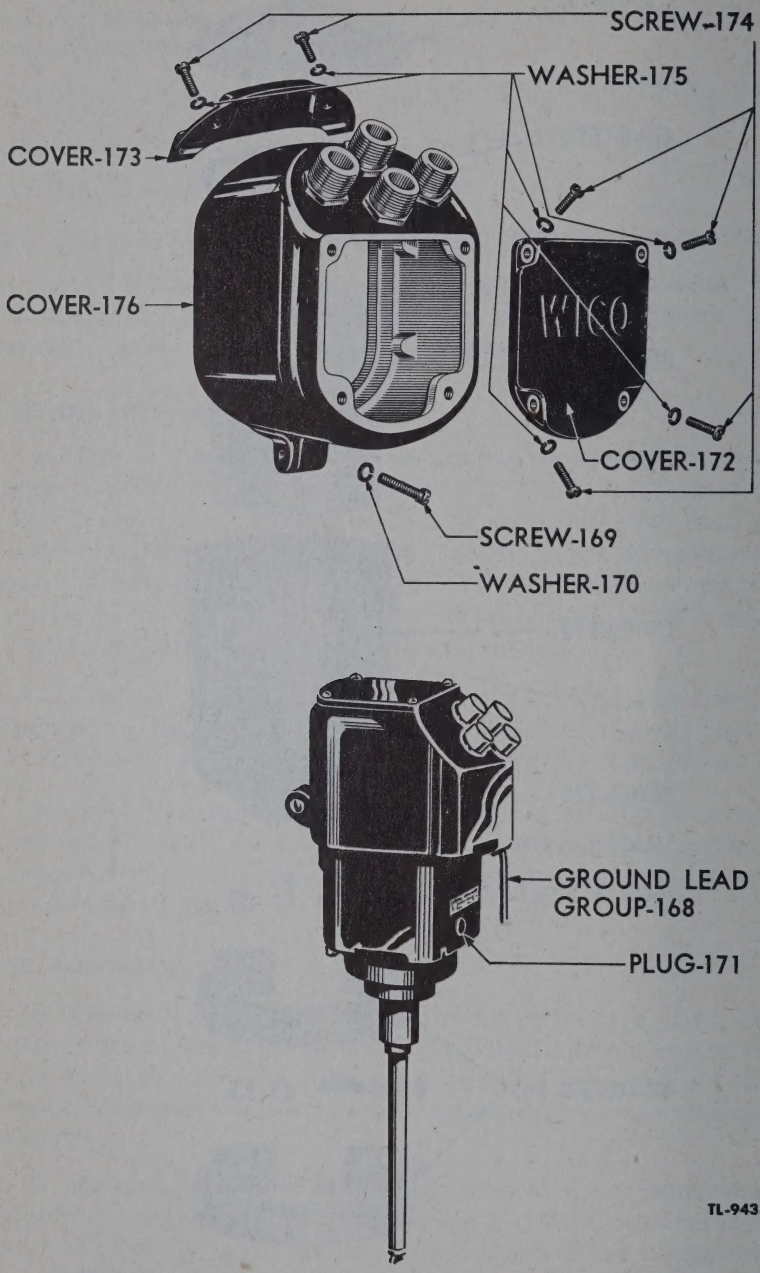

Figure 40. Magneto assembly.

will permit access to the distributor cap. The four lead wires should then be removed from the distributor cap terminals. The location of the lead wires with respect to their proper terminals should be observed so that they can be replaced in the same position on assembly. The distributor shield clamp screw (fig. 40 (169)) should be loosened sufficiently to free the shield on the main body of the magneto. This part can then be removed, exposing the distributor end of the unit.

c. Replacement of Radio Shielding. To replace the distributor shield after service adjustments have been made, set the shield on the main body of the magneto with the clamp screw on the vented side of the unit and positioned firmly on the locating bases on the inside of the shield. Tighten the clamp screw until the shield is locked securely in place. Place the lead wires in their original terminals and assemble the distributor shield and terminal covers.

d. Distributor Cap and Arm. After removing the distributor cap by loosening the four screws which hold it in place, the distributor arm may be pulled off the breaker cam. Before replacing the distributor arm, line up the key inside the breaker arm with the slot in the cam and press the breaker arm down. When replacing the distributor cap be sure that the gasket is in place.

e. Breaker Points. (1) To reach the breaker compartment, it is first necessary to remove the distributor cap, distributor arm, sealing washer, and breaker cover.

(2) The breaker points should be adjusted to .015 inch when fully opened. Adjustment is made by shifting the fixed contact (fig. 17 (198)), by means of the small, eccentric screw. After adjustment, tighten the fixed contact screw (fig. 17 (203)).

(3) The breaker points should be free of foreign matter. Lacquer thinner is an ideal cleaner for this purpose. Adjust the alignment of the points so that the full surface of both contacts meet squarely.

(4) To remove the breaker arm (fig. 17 (193)), take out the breaker clamp screw (fig. 17 (196)) lock washer and breaker arm clamp washer. Then the breaker arm may be pulled off the pivot. When replacing the breaker arm, make certain that the coil leads and ground lead are placed under the breaker arm spring screw washer.

(5) To remove the fixed contact (fig. 17 (198)), the breaker arm must first be removed as outlined above. Then pull off the breaker arm spacer (fig. 17 (192)) and spacing washer (fig. 17 (197)). After removing the fixed contact screw, lockwasher, and washer, the fixed contact may be pulled off the breaker pivot.

(6) If the points need replacing, it is recommended that both the fixed contact and breaker arm be replaced at the same time. After assembly the points should be adjusted as described in the beginning of this section.

(7) If it is desired to remove the breaker assembly as a complete unit disconnect the ground lead and insulated primary lead coil from the breaker spring screw. Remove the two breaker assembly screws (fig. 17 (200)), lockwashers, and plain washers, which hold the breaker plate to the housing and lift out the complete breaker assembly.

f. Capacitor. (1) The capacitor (fig. 17 (208)) should have a capacity of 0.16 to 0.18 microfarad. If when tested, the capacitor is below capacity, it should be replaced.

(2) To remove the capacitor, remove the breaker arm spring screw (fig. 17 (196)) and the two leads under it. Then take out the two capacitor mounting screws (fig. 17 (206)), and lockwashers, after which the capacitor may be lifted off the breaker plate. When re-replacing the capacitor, make certain that the capacitor case gasket (fig. 17 (205)) is in place.

g. Cam. (1) The cam is held to the end of the rotor shaft by a cam screw, lockwasher, and cam screw lock plate (fig. 17 (201)). In removing the cam, it may be necessary to tap the top of the rotor shaft very lightly with a piece of brass rod while pulling on the cam.

(2) To replace the cam, line up the key on the rotor shaft with the slot in the cam. Press the cam down firmly.

h. Removal of Drive and Impulse Mechanism. First remove the distributor cap, distributor arm, breaker cover and breaker cam. Then remove the two bearing plate clamp screws (fig. 16 (235)), and lockwashers, and pull the rotor, end plate, bearing plate, and impulse parts off the main housing as a unit. When replacing, make certain the oil plug in the bearing plate is

on the same side of the main housing as the nameplate and that the bearing plate gasket (fig. 16 (219)) is in place.

i. Inner Core. To remove the inner core, it is first necessary to remove all parts indicated previously, then proceed as follows:

(1) Pry out the inner core snap ring, and then press the coil down a little to give some clearance between the coil and the inner core.

(2) Place two screw drivers 180° apart under the inner core and pry it out, being careful not to damage the coil of the inner core. When the inner core is replaced, press it down as far as it will go and insert a new snap ring so that the split of the snap ring is over the split of the inner core.

j. Coil. (1) To test the coil, it is not necessary to remove it from the magneto. Remove the distributor cap, distributor arm and breaker cover. When using an Eiseman coil tester, connect the ground lead of the tester to the high tension spring on the magneto secondary pencil, turn the cam until the breaker points are open. The coil must be replaced if it requires more than 1.5 amp to give a steady spark on a 5 mm gap.

(2) If the coil is to be replaced, first remove the inner core, the breaker plate and disconnect all coil leads. Turn the coil leads up so that when the coil is removed the lead terminals will not catch on the housing.

(3) To replace the coil proceed in the following manner: Place two cambric coil shields (fig. 17 (214)) over the coil lead wire and insert the coil and shields so that the secondary contact spring on the side of the coil makes contact with the secondary pencil. Press the coil down firmly and insert the two coil edges so that they are on the same sides of the core as the split in the core.

k. Secondary Pencil. (1) The secondary pencil (fig. 17 (212)) serves the purpose of conducting high-tension current from the secondary terminal on the coil to the center terminal of the distributor cap, from which point the current is distributed in succession to each of the towers in the distributor cap.

(2) In order to replace the secondary pencil, it is necessary to remove the distributor cap, distributor arm breaker cover, cam, breaker plate from the distributor end of the magneto. From the drive end of the magneto it is necessary to remove the drive shaft,

rotor and impulse parts as a unit, inner core and coil. After these parts have been removed, the secondary pencil may be removed from the main housing by taking out the two secondary pencil screws (fig. 17 (200)) and lock washers.

l. End Plate and Impulse Mechanism. (1) After removing the two end plate clamp screws (fig. 16 (235)) and the end plate clamp screw lock (fig. 16 (234)), the end plate may be pulled off the drive shaft and free from the bearing plate by holding down the drive shaft while pulling upward on the end plate group. It may be necessary to strike the side of the end plate with an instrument such as the handle of a screw driver, to free it from the bearing plate, before it can be pulled off.

(2) The drive shaft with the cam and impulse springs may now be pulled off.

(3) To remove the cam plate from the drive shaft, clamp the cam plate in a vise and remove the cam plate clamp nut (fig. 16 (226)) and washer (fig. 16 (239)). After the clamp nut has been removed, the cam plate may be taken off the drive shaft by gently tapping the nut of the shaft.

(4) When reassembling, first, place the cam plate on the drive shaft, gently tapping into place if necessary. Then replace the cam plate clamp nut and washer. After this the two impulse springs (fig. 16 (228)) and the four impulse spring guides (fig. 16 (229)) should be assembled to the pins on the cam plate.

(5) If it is necessary to replace the impulse springs or guides it is recommended that the impulse spring group X4600 be installed as the use of this group greatly facilitates the assembly of the springs to the pivots on the cam plate and support plate. It is only necessary to push the two retaining cups together with the fingers and place the protruding loop over the pin, thus dispensing with the use of the crochet hook as mentioned previously.

(6) Make certain that the end plate gasket (fig. 16 (233)) is placed between the end plate and bearing plate.

m. Rotor, Bearing Plate, and Support Plate. (1) Remove the support plate from the drive shaft. Using a socket wrench and being extremely careful not to twist the rotor shaft, loosen the support plate clamp nut (fig. 16 (226)). If necessary, the support

plate may be pried off by placing two screw drivers 180° apart beneath it. After the support plate assembly has been removed, the rotor may be pulled off the bearing plate.

(2) The support plate assembly may be disassembled by removing the cotter pins from the trip arm pivot pins (fig. 16 (224)). After pulling out the cotter pin, the trip arm pivot pins (fig. 16 (223)) may be removed.

n. Timing to Engine. (1) Rotate the flywheel and bring the piston of No. 1 cylinder into firing position of compression stroke. The flywheel is marked to identify firing position.

(2) With the distributor cap removed, turn the magneto shaft in a direction opposite to its ordinary rotation until the monel metal segment of the distributor arm is opposite the No. 1 terminal of the distributor cap and the breaker points just begin to open. Clamp the magneto to the engine in that position. Complete the installation by replacing the distributor cap and connecting the remaining leads in their correct firing order.

(3) It is a good practice to recheck the timing under actual running conditions and make final adjustments by *slightly* advancing or retarding the magneto (slightly turning the housing) as may be required to obtain best engine performance.

o. Lubrication. The magneto requires a small amount of oil after each 512 hours of operation. See paragraph 25.

38. SPARK PLUGS.

The spark plugs must be removed, cleaned and adjusted at least once each month, or every 64 hours of operation. Scrape the carbon from both inside and outside of the body and wash the plugs in solvent. Adjust the point gaps to 0.025 inch by the aid of a feeler electrode as this will not damage the plug. Always adjust by bending the outer electrode or the one attached to the outer shell of the plug. When reassembling the spark plugs to the cylinder head, make sure that the gasket is replaced. Use a new gasket if possible, and be sure that the plug is screwed securely into the cylinder head.

39. VALVE ADJUSTMENT (fig. 42).

The intake and exhaust valves are provided with adjustable tappets to enable proper valve adjustment. These tappets are

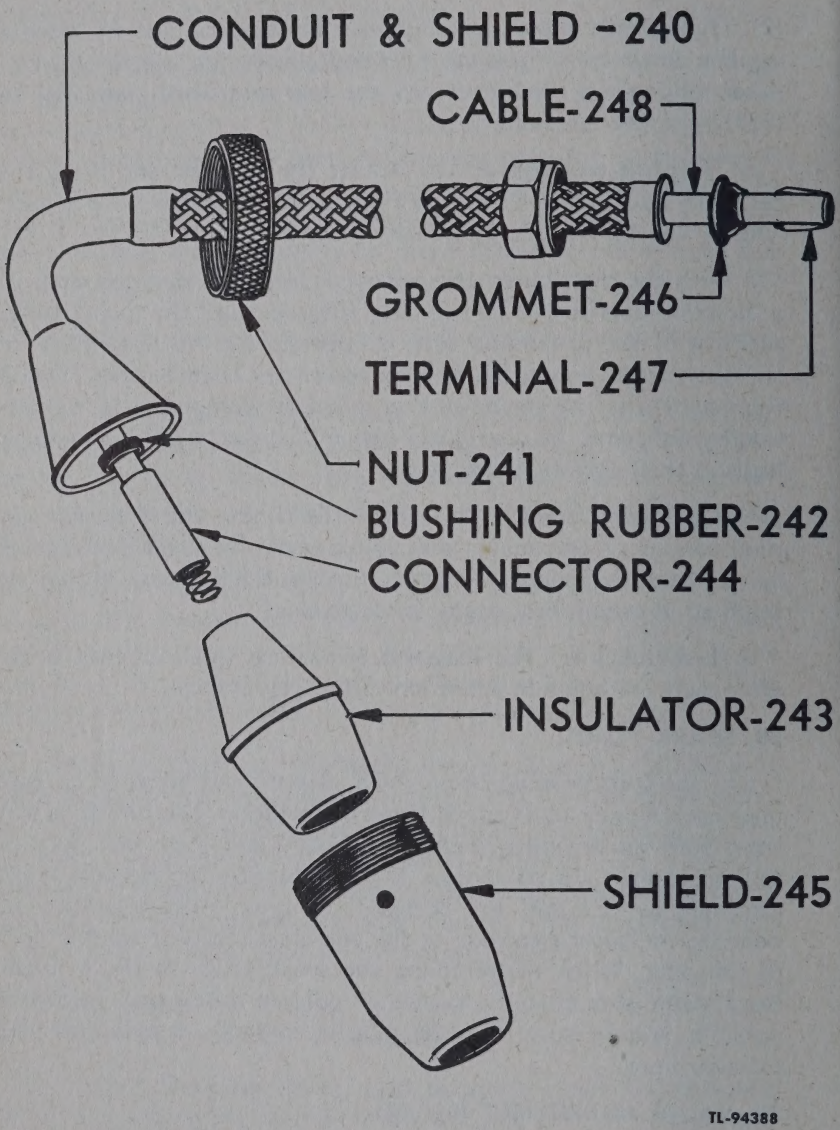

Figure 41. Conduit and radio shield assembly.

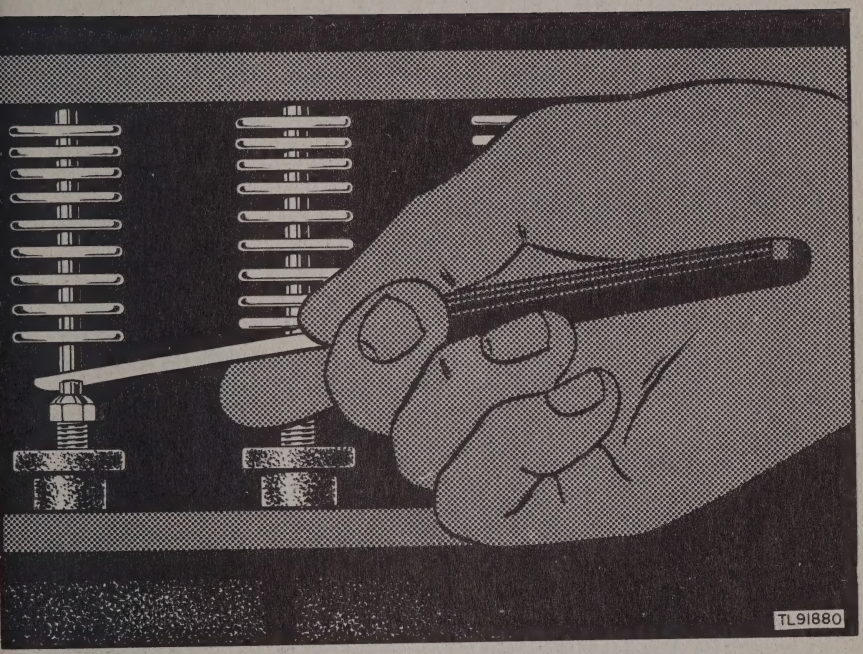

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Figure 42. Valve adjustment.

reached by removing the valve cover plate on the side of the cylinder block. The tappets should be checked every 150 operating hours and readjusted to 0.014 inch clearance when the clearance is found to exceed this figure. Adjust the tappets when the engine is cold and be sure that they are at their lowest point to avoid incorrect adjustment. One 7/16-inch open-end wrench and one 3/8-inch open-end wrench will be required. Always recheck the adjustments after tightening the locknuts to be certain that the adjustment has not shifted. Inspect the valve springs and other visible valve parts while the cover is off, and take any necessary steps indicated.

40. CYLINDER HEAD REMOVAL.

a. Removal. When it is necessary to remove the cylinder head for removing carbon, grinding valves, or other operations, proceed as follows: (1) Disconnect radiator hose, air cleaner hose, spark plug wires, etc. Using a 7/16-inch hexagon socket wrench, remove the cap screws that fasten the cylinder head to the cylinder block.

(2) Lift the head from the block, being careful not to damage the gasket. If the cylinder head does not come away freely, do not attempt to pry off. Replace a few of the cap screws loosely, and with the ignition off, crank the engine. The forces of compression should loosen the head so that it can be lifted off.

b. Replacement. (1) When replacing the head, coat both sides of the gasket (fig. 43 (34)) with cup grease and place it on the cylinder head. Use a new gasket if the old one is damaged or otherwise unfit for use.

(2) Line up the holes in the gasket with those in the top of the cylinder block, and lower the cylinder head in place.

(3) Replace the cylinder head cap screws, and screw them down as far as possible by hand.

(4) Using a 7/16-inch hexagon socket and torque wrench, tighten the cap screws. Do not pull any one screw down all the way, but tighten first one screw and then another, in the order of the numbers in figure 44. Take them up gradually until all of the screws show a tension of 42 foot-pounds or 504-inch-pounds on the torque wrench. If no torque wrench is available, follow the same pro-

cedure until all of the screws are moderately tight. Do not use too much force on the wrench as this might result in stripping the threads in the cylinder block or twisting off the head of the screw.

(5) Run the engine for a few minutes after replacing the head, and then take up any slack by taking another turn or two on each of the cap screws.

41. CARBON REMOVAL.

a. Carbon deposits must be removed from the cylinder head, the piston heads, the tops of the cylinder walls and from around the intake and exhaust valves about every 300 operating hours. Follow the instructions for removing the cylinder head (par. 40).

b. Scrape the carbon from the cylinder head, pistons, cylinder walls, and from around the valves with a carbon scraping tool. If such a tool is not available, the end of a file or similar instrument may be used. Be careful not to scar the heads of the pistons or the cylinder walls or allow carbon to fall underneath the valves.

c. Check the condition of the valves while the head is off and give them any attention necessary. If it is found that the valves are in need of grinding, proceed as follows: (1) Remove the valve cover plate from the side of the cylinder block.

(2) Insert the valve lifter between the valve tappet boss and the valve spring seat. Compress the valve lifter and using a pair of long-nosed pliers, remove the valve spring retainer pin from the valve stem.

(3) Release the valve lifter, remove it, and then lift the valve from its seat. Mark the valve so that you may be sure that it is returned to the same seat from which it was removed.

(4) Remove the valve spring and spring seat, and repeat the same operation for each valve until they have all been removed. Do not forget to mark each valve as it is removed from the cylinder block.

42. VALVE GRINDING.

a. Procedure. Remove the valves (par. 41 **c.**) and proceed as follows: (1) Select the valve from either end of the cylinder block. It is best to proceed from one end to the other instead of selecting valves at random.

(2) Place a light, even coating of fine valve-grinding compound on the face of the valve.

(3) Slip a light coil spring over the valve stem. This spring must be long enough to lift the valve from its seat when there is no pressure on it.

(4) Place the valve in position in the seat from which it was removed. The light spring on the valve stem should be below the head of the valve and resting on the valve stem guide boss. Be sure that the valve is in the correct seat.

(5) Using a valve grinding tool or screw driver, rotate the valve back and forth while pressing it lightly on its seat. Lift the valve by means of the spring every few rotations and give it a half turn while clear of the seat. Bear down again and continue the rotating action. Keep this up until a satisfactory seat has been ground. It may be necessary to renew the grinding compound from time to time.

(6) The valve may be assumed to be properly ground when both the valve face and valve seat present a smooth, silvery color. A bright, polished surface is not desirable.

(7) Remove the valve; remove the spring from its stem, and wipe off both the valve face and valve seat with a cloth dampened with Diesel oil or SD.

(8) Check the seat by placing pencil marks at close intervals around the face of the valve and then rotating it a half turn on its seat. If the pencil marks are evenly smudged all around the valve, it may be assumed to be properly ground.

(9) Follow the same procedure (subpar. (2) through (8) above) until all of the valves have been properly ground.

(10) Be sure to remove any valve-grinding compound that may have found its way into the valve pockets below the valve seats or other parts of the engine.

b. Reassembly. (1) Reassemble the valves in their seats by reversing the operations for removal. Be sure that each valve is returned to the seat from which it was removed and to which it has been ground.

(2) Replace the cylinder head (par. 40).

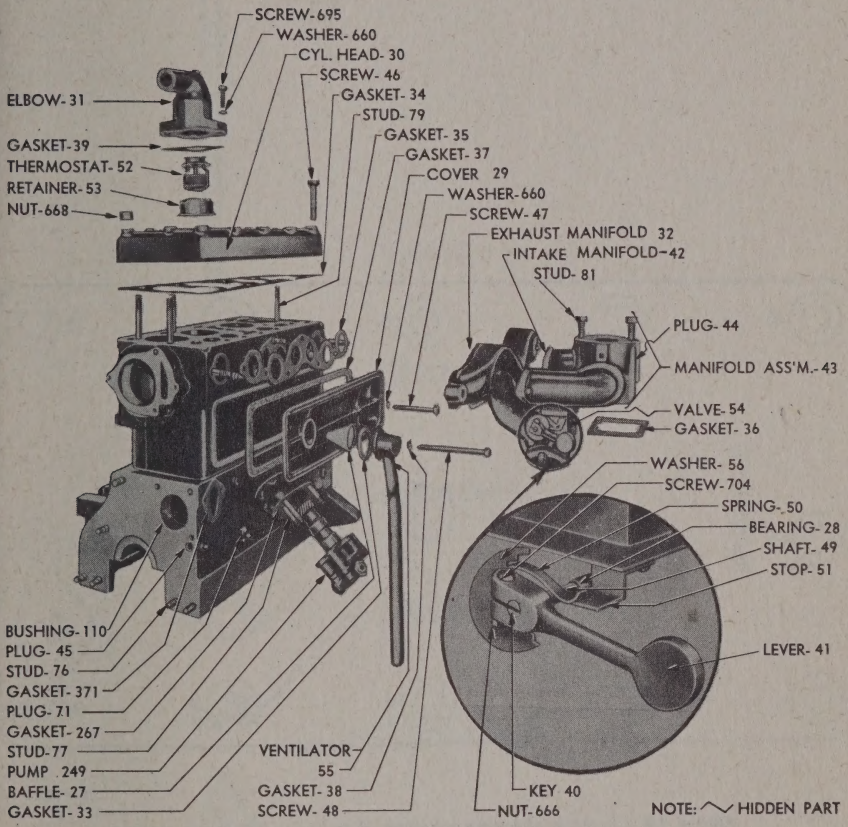

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Figure 43. Cylinder head, manifold, and valve cover.

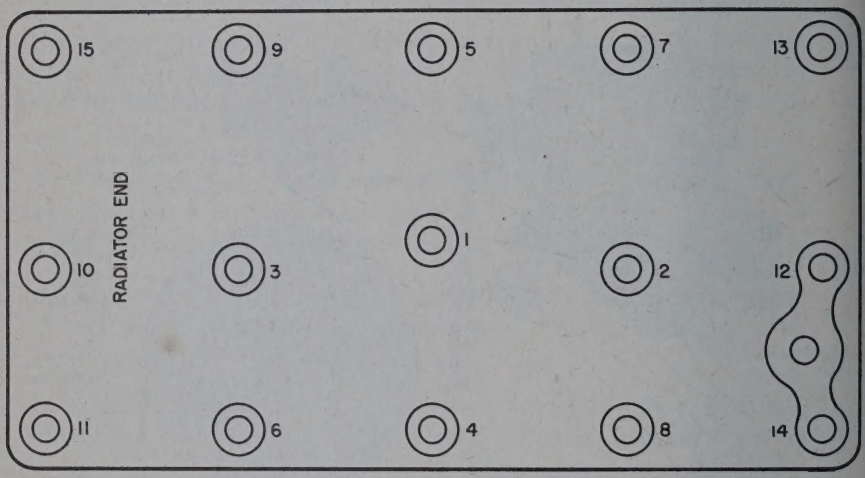

Figure 44. Diagram showing location of cylinder-head cap screws.

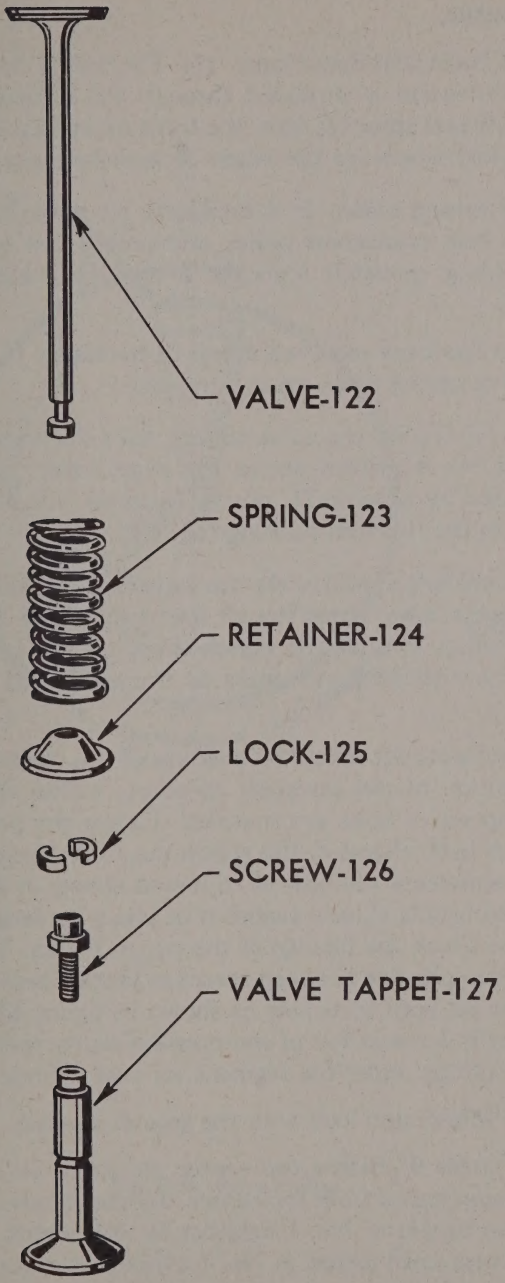

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Figure 45. Valve.

43. VALVE TIMING.

a. Timing Chain and Sprockets. (1) The timing chain is non-adjustable. Lubrication is provided through the drilled passages in the crankshaft and sprocket from the front main bearing. These should be checked whenever the chain or sprockets are replaced.

(2) To replace timing chain, it is necessary to remove radiator, fan blades, fan belt, crankshaft pulley and timing case cover. Remove bolts holding camshaft sprocket to camshaft and remove chain.

(3) When chain has been removed it will be necessary to carefully observe the valve timing when chain is replaced.

b. Timing. (1) To set the valve timing, turn the crankshaft so that No. 1 and No. 4 pistons are at top dead center. Top dead center is indicated by a mark TC on the flywheel which is visible through a hole in the flywheel housing (fig. 47).

(2) Place the camshaft sprocket on the camshaft and line up the holes for the cap screws. Screw in all four cap screws by hand. Rotate the camshaft so that the punch mark on the face of the sprocket is in line with the punch mark on the crankshaft sprocket (fig. 48).

(3) Remove the camshaft sprocket and install the timing chain. Change the position of the camshaft sprocket, within the chain, until all four cap screw holes are matched. Unless the position of the camshaft has been changed, the punch marks on the camshaft and crankshaft sprockets will now be in line as shown in figure 48. Make sure the camshaft thrust washer is in place, replace the cap screws and again check the line-up of the punch marks. Timing is correct when a straight line between sprocket centers cuts through the punch marks on both sprockets as shown in figure 48. In this position No. 4 cylinder is at top of compression stroke and the distributor arm should be under the segment for that cylinder.

(4) Tighten cap screws and lock with the special washers.

(5) Inlet valve opens 9° before top center measured on flywheel or .039 inches piston travel from top center. To check valve timing, adjust inlet valve tappet of No. 1 cylinder to .020 inches. Rotate crankshaft clockwise until piston in No. 1 cylinder is ready for the intake stroke. At this instant the tappet should be tight against

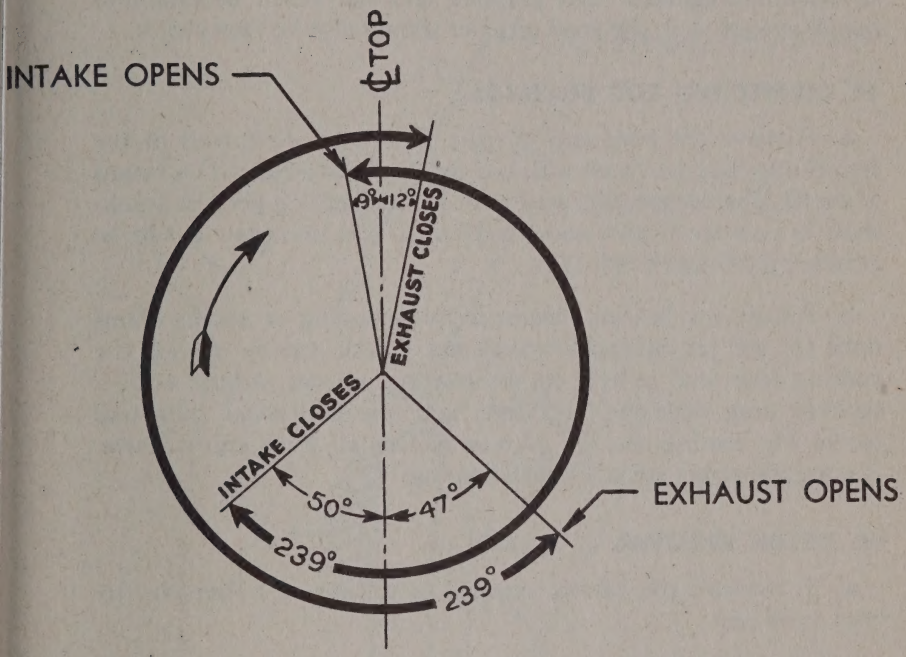

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Figure 46. Valve timing.

end of the valve stem and the mark "I. O." on the flywheel should be in the center of the timing hole in the flywheel housing (fig. 47).

c. Timing Chain Cover Seal. The crankshaft oil seal is woven asbestos impregnated with graphite and oil. When necessary to install new oil seal, the steel retainer should also be renewed.

44. CONNECTING ROD BEARINGS.

a. Remove the base and oil pan. The crankshaft ends of the connecting rods are fitted with bearing caps and adjusted by means of shims. The correct clearance between the bearing and the crankshaft is between 0.0008 and 0.0023 inch. The end play should be between 0.005 and 0.009 inch.

b. Adjust the bearing clearance by removing or adding shims until the correct clearance is attained. Check this by moving the bearing from end to end on the bearing journal. Adjust until a definite drag develops, and then add one additional shim and secure the bearing cap. Be sure to replace all locks and washers. Repeat the above steps for each bearing.

45. PISTON REMOVAL.

a. To remove the piston, proceed as follows: (1) Remove the base or oil pan.

(2) Remove the bearing caps from the crankshaft ends of the connecting rods.

(3) Remove the cylinder head (par. 40).

(4) Push the piston out of the cylinder by pushing on the connecting rod (fig. 50 (90)) and withdrawing it from the cylinder. Be careful not to scar the cylinder walls with the end of the connecting rod. Be sure to mark each piston and connecting rod assembly so that it may be returned to its original location.

b. Replace piston and other parts that have been removed.

46. PISTON, PINS, AND RINGS.

a. Remove piston and connecting rod assemblies (par. 45).

b. Check the piston pin clearance. If it is over 0.009 inch it will be necessary to replace the piston pin bushings in the piston. This

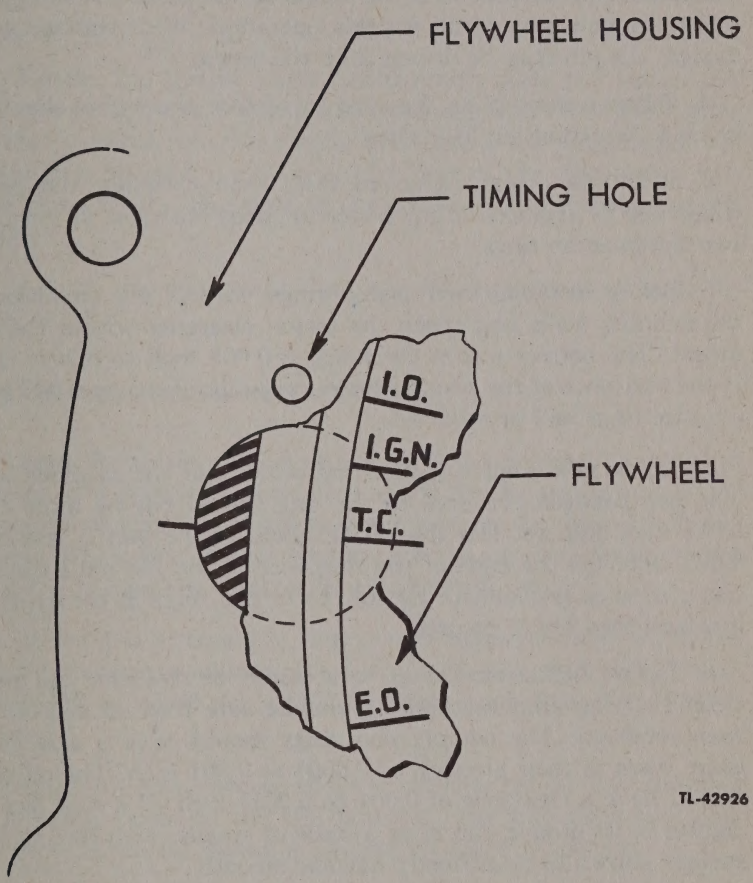

Figure 47. Timing marks.

can be accomplished only where suitable equipment is available. It may be possible to take up play by fitting an oversize piston pin.

c. The piston pin may be removed from the piston by loosening the piston pin lockscrew on the inside of the piston. A hexagonal socket wrench is required for this operation. With this screw removed, the pin may be driven from the piston.

d. When reassembling, be sure to replace the lockwasher that secures the piston pin lock screw.

e. With the pistons removed from their cylinder, the piston rings may be replaced. Each piston is fitted with one oil ring and two compression rings.

f. Before installing new piston rings, inspect the condition of the cylinder walls and check the piston clearance within the cylinders. The correct piston clearance is 0.003 inch to 0.0025 inch. If the clearance of the piston within the cylinder is over 0.003 inch, oversize rings will be required.

g. To fit new rings, slip the ring down into the cylinder bore. The gap between the ends of the ring should not be more than 0.013 inch and not less than 0.008 inch. If the gap is less than 0.008 inch, file the ends of the ring with a fine file until the correct clearance is attained. Be sure to fit the rings in the cylinders in which they are to be used.

h. Before fitting new rings to a piston or replacing old rings, clean the ring grooves carefully and be sure that all carbon has been removed. The compression rings should have a side clearance, when in their grooves, of 0.0005 to 0.001 inch. The oil rings should have a clearance of 0.001 to 0.0015 inch. If a ring fits too tightly in its groove, lap it on a piece of crocus cloth resting on a surface known to be perfectly flat and smooth.

47. PISTON ASSEMBLY INSTALLATION.

a. When all necessary work on the piston assembly has been completed the pistons may be installed in their respective cylinders.

b. Insert the piston assembly in the cylinder from which it was removed and to which the piston rings were fitted. Use a ring compressor to compress the rings. If a ring compressor is not available, tie each ring so that it is fully compressed with a piece of string.

c. Press the piston assembly down into the cylinder and as each ring enters the cylinder bore, cut the string on that ring. If a ring compressor is being used, the piston and ring assembly will slide out of the compressor into the cylinder. Tap the top of the piston lightly with a hammer handle to drive it down into the bore of the cylinder.

d. Rotate the piston within its cylinder until the piston pin lockscrew is on the side toward the camshaft, and lower the assembly into position on the crankshaft. Insert the connecting rod bearing cap bolts in the holes in the base of the connecting rod. Place three 0.003 inch shims on the bolts and slip the bearing cap in place.

e. Adjust the connecting rod bearing as instructed in paragraph 44.

48. STARTING MOTOR REPLACEMENT.

a. Aside from the replacement of the brushes, cleaning the commutator, and possible replacement of the Bendix spring, no service of the starting motor should be attempted in the field. However, in cases where the above troubles are the obvious cause of the difficulty, replace the complete starting motor unit.

b. When it is necessary to remove and replace the starting motor (fig. 26) proceed as follows: (1) Using a 9/16-inch open-end wrench, remove the terminal nut and the battery cable from the starting motor.

(2) Using the same wrench, remove the three cap screws that hold the starting motor to the bell housing. The starting motor may now be removed by sliding it toward the front of the unit.

(3) With the starting motor removed, check the Bendix spring and replace it if necessary.

(4) Before replacing the starting motor on the engine, clean the pinion shaft thoroughly with Diesel oil or SD and give the worm a light application of light engine oil.

(5) Reassemble the starting motor to the unit by reversing the above procedure.

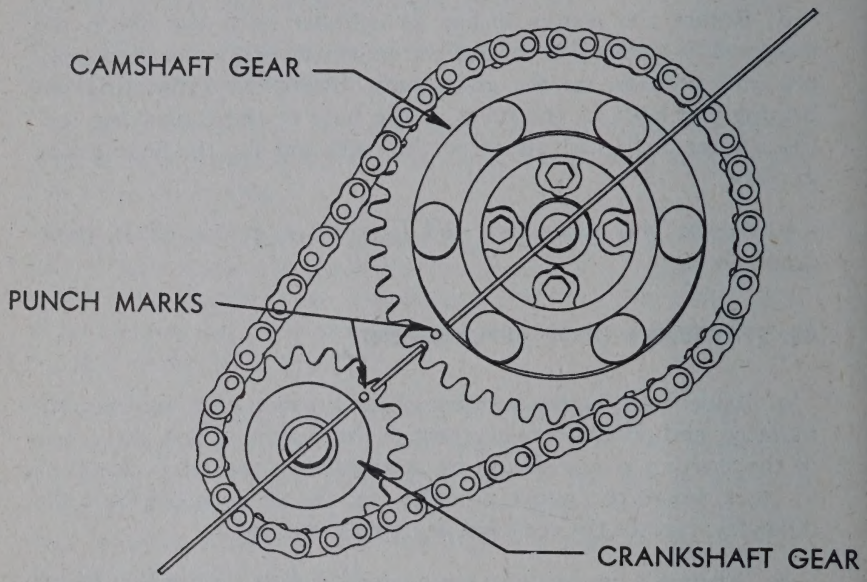

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Figure 48. Timing sprockets.

49. WATER PUMP REMOVAL.

a. When it is found necessary to remove the water pump from the engine, proceed as follows: (1) Before attempting to disassemble the water pump from the engine, drain the radiator.

(2) Loosen the fan belt by loosening the idler pulley cylinder.

(3) Remove the fan.

(4) Disconnect the lower radiator hose.

(5) Remove the three bolts that mount water pump to engine.

(6) Slip the water pump forward, and remove from the engine.

b. Reverse the above procedure to replace water pump.

50. OIL PUMP REMOVAL.

a. When it is found necessary to remove the oil pump from the engine, proceed as follows: (1) Remove the three nuts on studs holding oil pump to crankcase.

(2) Slide oil pump from studs.

(3) Remove screw (fig. 52 (255)) in oil pump cover plate which will allow cover to be removed from housing.

(4) To remove driven gear (fig. 52 (265)), file off one end of straight pin (fig. 52 (266)) and drive pin through the shaft.

(5) The oil shaft and rotor (fig. 52 (260)) can be removed from the body in an assembly.

(6) When removing spring retainer (fig. 52 (250)), care must be taken not to lose the small washers (fig. 52 (252)).

(7) Adding shims will increase the oil pressure; removing shims will decrease it.

b. When replacing the oil pump on engine the following procedure should be followed in order to have correct timing for the ignition: (1) Set No. 1 piston coming up on the compression stroke, then turn the flywheel so that the timing mark IGN appears on the flywheel in the center of the hole in the flywheel housing on the right-hand side (fig. 47).

(2) Set the distributor rotor at No. 1 terminal tower in distributor cap and with the points just breaking.

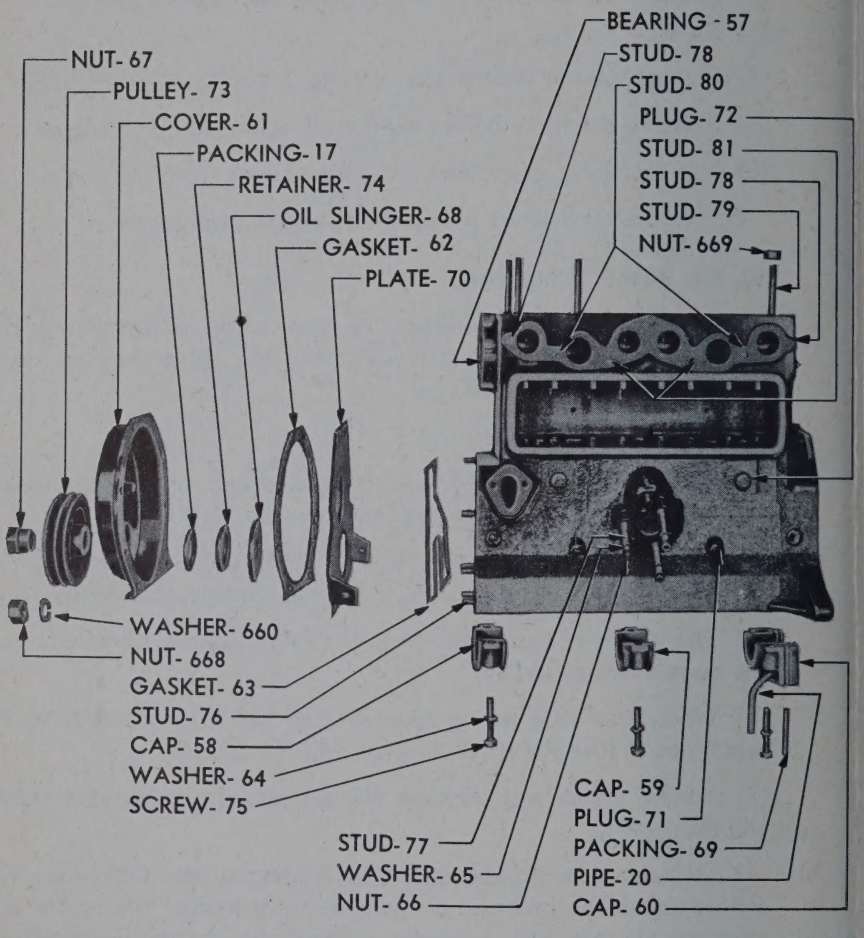

Figure 49. Timing chain cover and cylinder block.

(3) Hold the oil pump in one hand with the oil relief valve retainer in the same position as it would be when installed in the engine; turn the shaft so that the narrow side of the slot in driven gear end is toward you, then line up the pin holding driven gear to shaft so that it will fall in line with the right-hand side of the slot in the pump body (fig. 52 (264)). Slide the assembly on studs in the crankcase: feed gear slowly into camshaft gear, noting when fully set if the rotor on distributor has moved from its original setting. If so, remove oil pump and turn one tooth to obtain the correct setting.

51. CAMSHAFT REMOVAL.

a. If it should be necessary to remove or replace the camshaft, the following operations will be necessary: (1) Remove the base, or oil pan.

(2) Remove the cap screws that hold the gear cover to the cylinder block. This cover may now be removed.

(3) Remove the valves (par. 41 **c.**).

(4) Lift all eight valve tappets clear of the camshaft and fasten them so that they will not drop back on the camshaft while it is being removed.

(5) The camshaft may now be pulled out through the gear case end of the engine.

b. Reassemble the camshaft by reversing the procedure for disassembly. Be sure to replace all gaskets and washers when reassembling. Use new gaskets when the old ones are unfit for use, and be sure to clean thoroughly all surfaces before reassembling so that the gaskets will make good contact.

52. CRANKSHAFT REMOVAL.

a. Refer to paragraph 53 for details concerning the removal of the engine from the unit.

b. Before removing the crankshaft, it is advisable to first remove the flywheel.

c. Refer to paragraph 50 for the removal of the oil pump. Remove the oil pump.

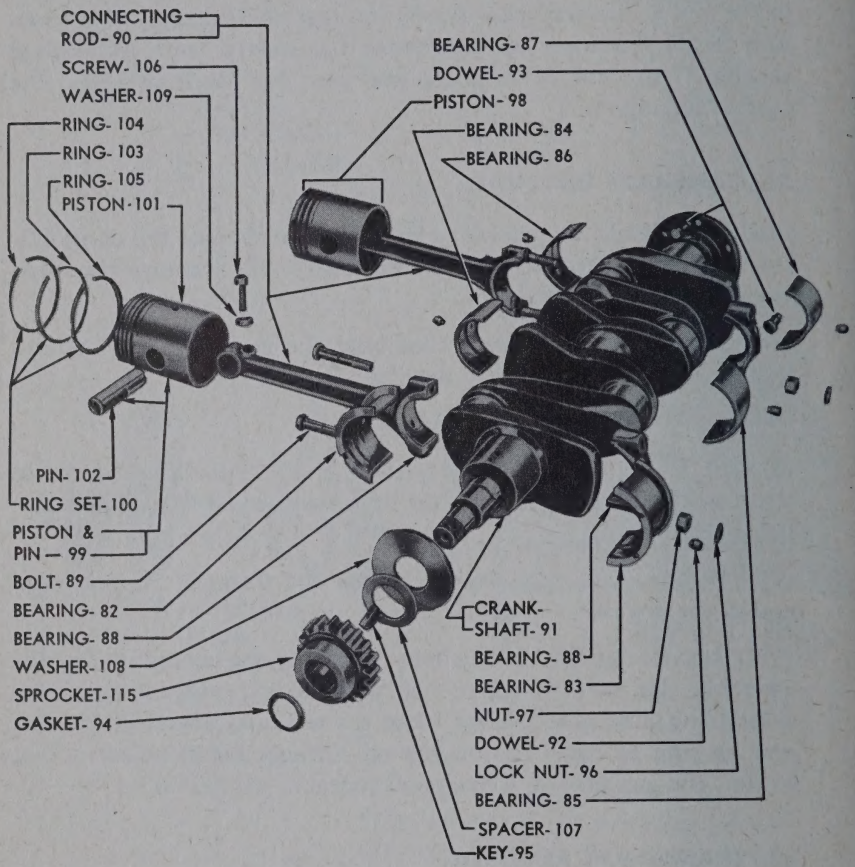

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Figure 50. Crankshaft, connecting rods and pistons.

d. Remove the connecting rod caps and keep them in the correct relationship with the connecting rods (fig. 50).

e. Remove the main bearing caps and this will allow the removal of the crankshaft.

53. ENGINE REMOVAL.

a. When it is found necessary to remove the engine (figs. 6 and 7) from the unit, proceed as follows: (1) Drain the oil from the base of the engine.

(2) Drain all liquid from the radiator and water jacket.

(3) Remove all connections between the engine and radiator.

(4) Remove the fuel pipe between the fuel strainer and fuel pump.

(5) Disconnect all wires between the engine and other parts of the unit. Tag the wires as they are removed so as to be sure they are returned to their proper places.

(6) Remove the radiator, and radiator mount.

(7) Disconnect the engine from the generator.

(8) Check to make sure that there are no remaining connections of any kind between the engine and other parts of the unit.

(9) Remove the fastenings that secure the engine to the base, then slide the engine forward to disengage it from the generator, and lift it from the base.

(10) For convenience in handling the engine, remove all piping and accessories. These include the air filter, carburetor, fuel strainer, oil drain cock, muffler, oil and water fillers, oil filter, fuel pump, starting motor assembly, and spark plugs and wiring.

(11) Tag wires in order to return them to their proper places, and plug the spark plug holes to prevent dirt from getting into the cylinders.

b. Reverse procedure above to replace the engine.

54. ENGINE CLEARANCES.

	Minimum	Maximum
Between valve tappets and valve stem..	0.014 (cold)	
Between intake valve stem and guide...	0.0015	0.00325
Between exhaust valve stem and guide..	0.002	0.00375
Between valve tappet and guide.....	0.0005	0.002
Crankshaft end plate (governed by front main bearing).....	0.004	0.006
Connecting rod clearance on crankshaft.	0.0008	0.0023
Connecting rod side clearance.....	0.005	0.009
Between piston and cylinder wall.....	0.003	0.0025
Piston rings to piston grooves		
(1) Compression rings.....	0.0005	0.001
(2) Oil rings.....	0.001	0.0015
Piston ring end gap.....	0.008	0.013
Piston pin.....	0.0001	0.0009
Main bearings (crankshaft).....	0.001	
Spark plug gap.....	0.030	
Magneto breaker point gap.....	0.015	

55. COMMUTATOR AND SLIP RINGS.

a. Remove the generator end cover (fig. 20 (416)) once each month and inspect the commutator slip rings and brushes. If the commutator or slip rings appear in need of cleaning, use a flat, dry stick and a piece of cloth. Place the cloth over the end of the stick, and dampen the cloth with cleaning solvent. Hold the flat side of the stick so that the cloth will come in contact with the surface of the commutator or slip rings while the unit is running at idle speed. This will remove any normal accumulation of dirt. If the commutator or slip rings are badly in need of cleaning, follow the same procedure but substitute a piece of No. 0000 sandpaper in place of the solvent-moistened cloth. NEVER USE EMERY.

b. After a short period of use, the commutator and slip rings will take on a smooth mahogany color which is a natural condition and not an indication of need for cleaning. A bright, highly polished surface is not necessary.

c. Slight roughness of the commutator surface may be improved by holding a piece of No. 00 sandpaper against the commutator surface, while the engine operates slowly. Lift brushes in the holders

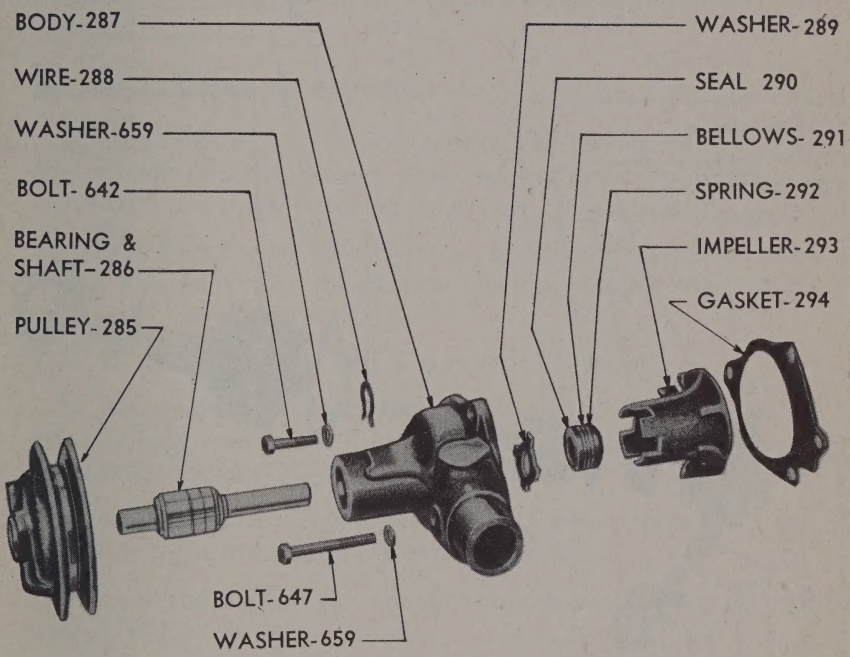

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Figure 51. Water pump assembly.

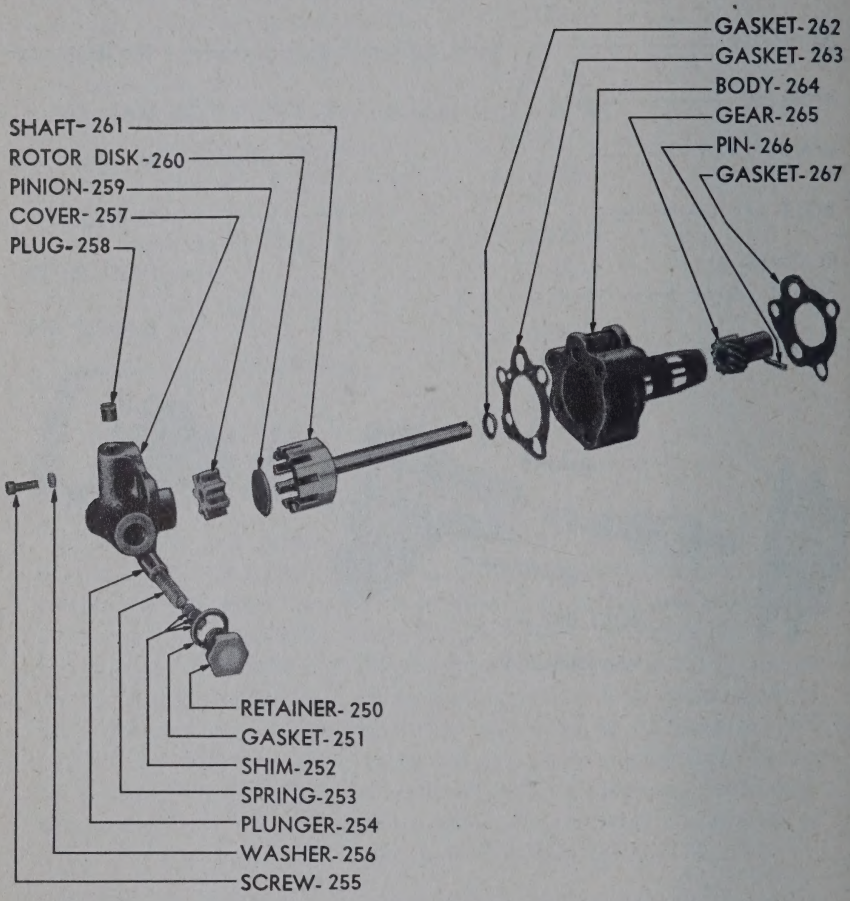


Figure 52. Oil pump.

while performing this operation. A badly worn or pitted commutator requires refinishing in a lathe at a repair depot.

d. After a commutator has been refinished or when the copper has worn down even with the mica insulation between the segments or bars, the mica must be undercut $\frac{1}{32}$ inch as shown in figure 54. This operation must not be attempted by unauthorized personnel.

56. REPLACEMENT OF BRUSHES.

a. Disassembly. (1) Remove the exciter bearing bracket cover. Remove the machine screws, nuts and lock washers holding the louvered, sheet-metal cover on the exciter bearing bracket.

(2) Disconnect the pigtail connection. Loosen the connection screw on the bracket holding the brush to the commutator, and slide out the pigtail connection lug.

(3) Lift the brushholder arm, and remove the brush.

b. Brush Installation. (1) Install pigtail connection. Slide the brush pigtail connection lug under the connection screw on the brushholder bracket. Tighten the screw.

(2) Install the brush. Lift the brushholder arm, slide in the brush, and drop the arm to the brush securely in place.

(3) Install the cover. Place the cover in position, securing it with screws, lock washers, and nuts.

c. Sanding Brushes. Sand new brushes to a good seating contact as follows: (1) Place a strip of No. 00 sandpaper around the commutator, sanded side out, with the brush resting on the sanded surface with normal spring tension. Make sure the sandpaper contacts a large area on the commutator on each side of the brush.

(2) Pull the sandpaper in the direction of armature rotation.

(3) Raise the brush for the return stroke.

(4) Repeat until a proper seating surface is obtained.

57. REMOVAL OF BRUSHHOLDERS.

a. Removal. Follow steps 1 through 7 of paragraph 58 **a.** for the removal of the exciter head; then proceed as follows:

(1) Remove the exciter coil lead from the brushholder.

(2) Remove the screws that hold the exciter field pole pieces. Use care in the handling of coils and note EXACT position and relation of coils and leads.

(3) Remove capacitor lead.

(4) Loosen the brushholder mounting screws on both sides of the head.

b. Replacement. (1) The outer slip ring brushholder is placed at the bottom of the exciter head.

(2) See that the commutator brush sockets with brushes are in a position half way between adjacent exciter field poles.

(3) Tighten set screws on sides of head.

(4) Reconnect the capacitor. The capacitor mounts on the exciter head just to the right of the hole in the head through which the exciter leads come out.

(5) The short lead of the exciter coil connects to the lower left-hand commutator brush and faces the large opening of the housing.

(6) Set the coils so their connections are towards the operator and with the first coil connected to the brushholder set at the bottom of the head, progress counter clockwise around the head.

(7) Wrap the pole pieces with insulation board. Insulate the coils from the flux ring and insulate between the pole piece ear and coil.

(8) Bring the long lead of the last coil over the last coil and out through the hole in the head.

58. ARMATURE REMOVAL.

a. To remove the armature, proceed as follows: (1) Remove the exciter lead from the rheostat by means of a ¼-inch end wrench.

(2) Remove the field lead.

(3) Remove corner from the exciter head.

(4) Raise the commutator and slip ring brushes.

(5) Remove cap screws that hold the exciter head to the generator body.

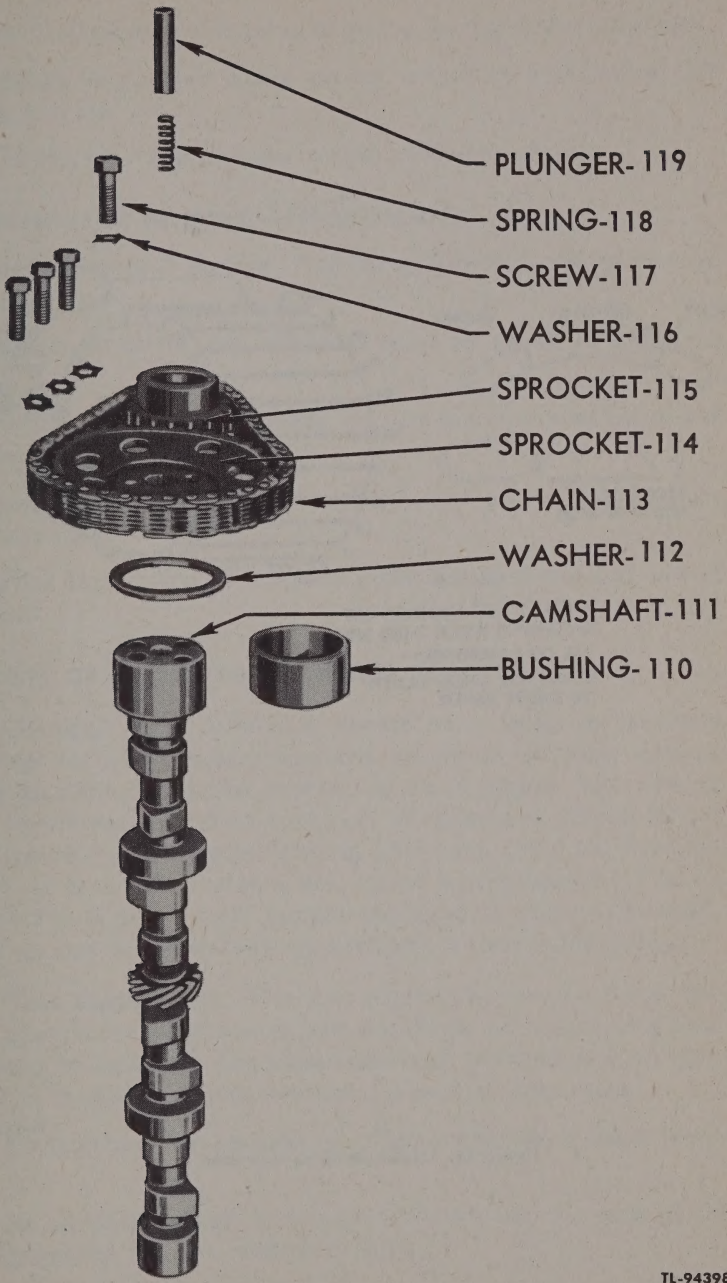
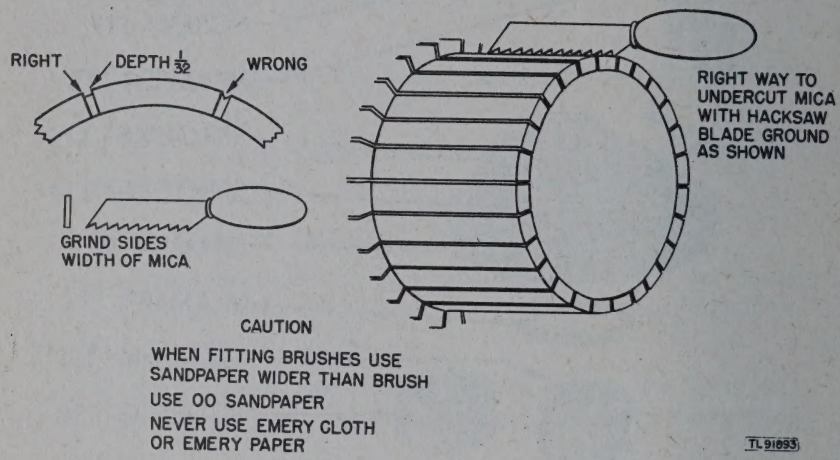


Figure 53. Camshaft Assembly.



TL-91893

Figure 54. Undercutting commutator.

(6) Tap head on edge of housing to disengage seat from stator body.

(7) Remove head, then grasp exciter armature with hands, lift slightly and pull out.

b. To replace the armature, reverse procedure above.

59. GENERATOR BEARING REPLACEMENT.

a. Follow steps 1 through 7 of paragraph 58 **a.** for removal of the exciter head.

b. Remove bearing from armature shaft by means of a bearing puller.

c. When replacing the bearing, be sure sealed side of bearing is next to slip ring.

d. Use a soft hammer or brass punch and tap bearing onto the armature shaft.

e. Pack the bearing with a good grade of cup grease and replace the head.

60. TESTS OF GENERATOR WINDINGS.

a. General. It is possible to locate most faults in generator windings without disassembling the generator. In each instance where an exciter armature winding or an alternator field winding tests open-circuited, short-circuited, or grounded, install a new rotor assembly. If a stator winding tests open-circuited, short-circuited, or grounded, install a new stator winding assembly unless the trouble is in the leads outside the winding proper. Generator windings can be successfully repaired only at a rewinding shop.

b. Test Equipment. The tests require the use of a 6-volt battery, a 6-volt lamp and socket, two test prods, and connecting leads as shown in figure 57. The same tests may be made with an ohmmeter, if available. A voltmeter can be used on some tests.

c. Preliminary Procedure. (1) Remove the cover from the exciter.

(2) Lift all brushes high in their holders and set the ends of the springs against them to hold them high.

(3) Disconnect the stator winding cables from the circuit breaker

terminals CD and EF back of the panel in the control panel box (fig. 24).

(4) Disconnect exciter cable from terminal on switch.

(5) Tag cables to avoid errors in replacing them.

d. Testing Stator Windings for Grounds. Touch one test prod to the stator frame, the other prod to the cable terminal in the control panel box. If the lamp lights, the stator winding is grounded. Test each winding separately. Inspect cables carefully throughout their lengths; the ground may be in the cable instead of the winding. If so repair the defective section of cable with successive layers of rubber tape and friction tape. If the winding itself is grounded, a new winding assembly must be installed.

e. Testing Stator Windings for Open Circuits. Touch one test prod to cable terminals at each end of one stator winding. If lamp does not light, the winding is open-circuited. Repeat the test, sticking the prods through the cable insulation and into the copper conductor in the cable near the terminals. If the circuit does not test *open* on this operation, it indicates a loose terminal on the cable. If so, repair connection and solder securely. Repeat test for other stator winding.

f. Testing Stator Windings for Short Circuit. Touch test prods to terminals of the different windings. If lamp lights, the windings are shorted together. If tests indicate a short circuit, check cables. If the short is caused by faulty cable insulation, make the necessary repair. If the short is in the stator winding proper, replace the stator winding assembly.

g. Testing Alternator Field Winding for Open Circuit. Touch one test prod to each collector ring. If the lamp does not light, the field circuit is open.

h. Testing Alternator Field Winding for Short Circuit. If a considerable number of turns are shorted, the winding will not be as warm as normal when the unit is running. A partial loss of power will also be apparent. Shorting of a small number of turns will not interfere with operation of the unit.

i. Testing Rotor Windings for Grounds. Touch one test prod to the rotor shaft and the other to a collector ring. If the lamp lights, the alternator field winding is grounded. Touch one test

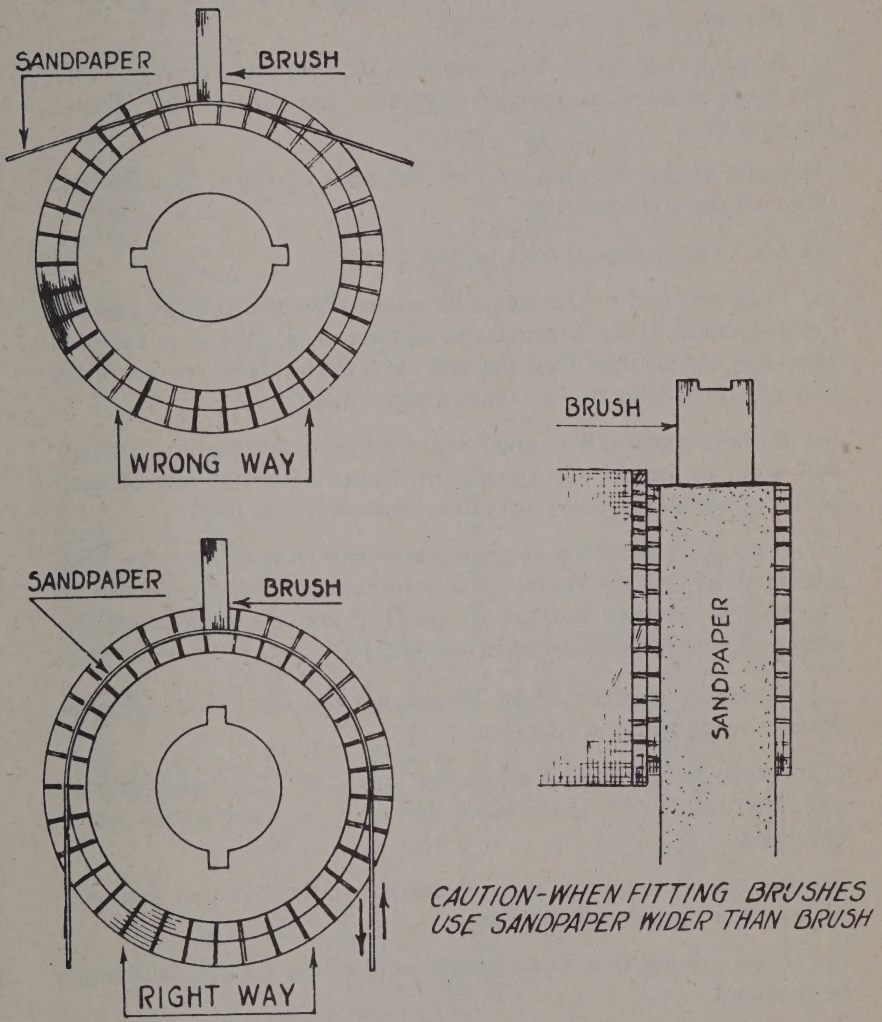


Figure 55. Fitting brushes to commutator.

prod to the rotor shaft and the other to the exciter commutator. If the lamp lights, either the exciter armature winding or the commutator is grounded.

j. Testing Exciter Armature for Open or Short Circuit. (1) Remove exciter end cover.

(2) Strip the insulation back about ½ inch from the ends of a one-foot piece of many stranded copper wire, No. 10 or larger. Spread the strands.

(3) Raise exciter brushes and set the ends of the springs to hold them off the commutator.

(4) Start the engine. Run it at normal speed.

(5) Hold one end of the test wire against the sharp edge, not the brush surface, of the commutator approximately midway between two adjacent brushes. Pass the other end of the wire over one brush and touch the edge of the commutator similarly.

(6) If the armature is in good order a heavy short-circuit current will build up quickly and result in a heavy flash at one or both points of contact. *Do not maintain contact after the flash.*

(7) If no flash develops at once, move the ends of the wire back and forth to find the correct points of contact near the centers of the spaces between brushes. If no flash can be developed, the armature is defective and must be replaced.

k. Testing Exciter Field Windings for Grounds. (1) Disconnect leads to the windings.

(2) Touch one test prod to exciter frame and the other end to each lead separately. If the lamp lights, the winding under test is grounded.

(3) Inspect the leads. If the ground is in a lead, repair the lead with rubber tape and friction tape.

(4) If the ground is in the winding proper, the exciter field must be removed.

(5) Remove screws from one field pole shoe at a time, push the pole shoe and coil away from the frame, and test again for ground. The ground is in the coil last loosened before the test indicates the ground has been removed.

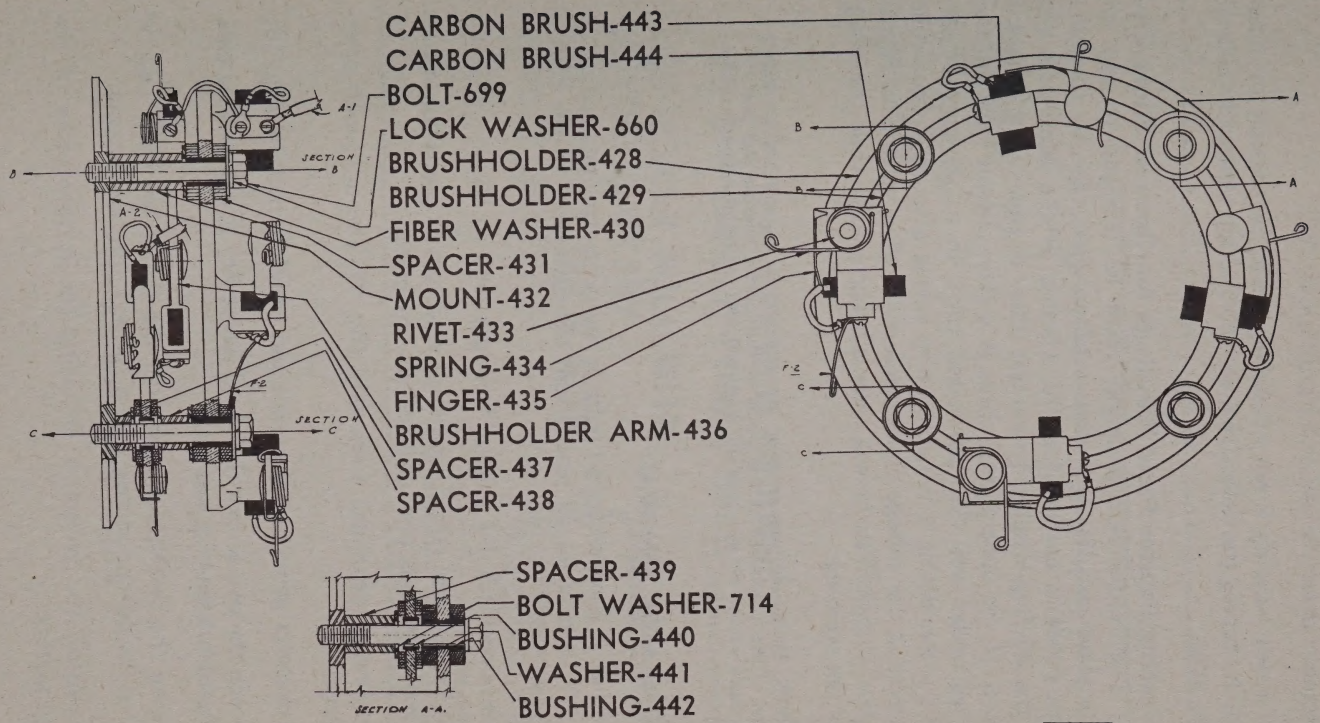


Figure 56. Brush holder assembly.

(6) Remove defective coil and install a new coil.

(7) If a new winding is not available, it may be possible to repair the coil by taping the defective area with friction tape and shellacking the area.

l. Testing Exciter Field Windings for Open or Short Circuits. The exciter field assembly must be removed to test for open or short circuits. Test each winding separately, by touching the test prods at each end of the winding. If the lamp does not light, the winding is open. Touch test prods to ends of the different windings. If the lamp lights, there is a short circuit between the windings under test. Short-circuited turns in a coil may be detected by connecting a 6-volt battery across a series of four coils and checking the voltage across each coil with a voltmeter. A coil with short-circuited turns will show a lower voltage than the other coils of the winding.

> **NOTE:** Be careful, when using a voltmeter, to connect the positive lead of the voltmeter at the point in the circuit nearest the positive terminal of the battery and the negative lead to the point nearest the negative terminal.

61. GENERATOR REMOVAL.

a. When it is necessary to remove the generator, proceed as follows: (1) Disconnect all leads from the generator to the control panel box.

(2) Disconnect gas line leading from gas tank to filtrap.

(3) Disconnect and remove gas tank, and control panel box mount from skid (leave gas tank and control box intact).

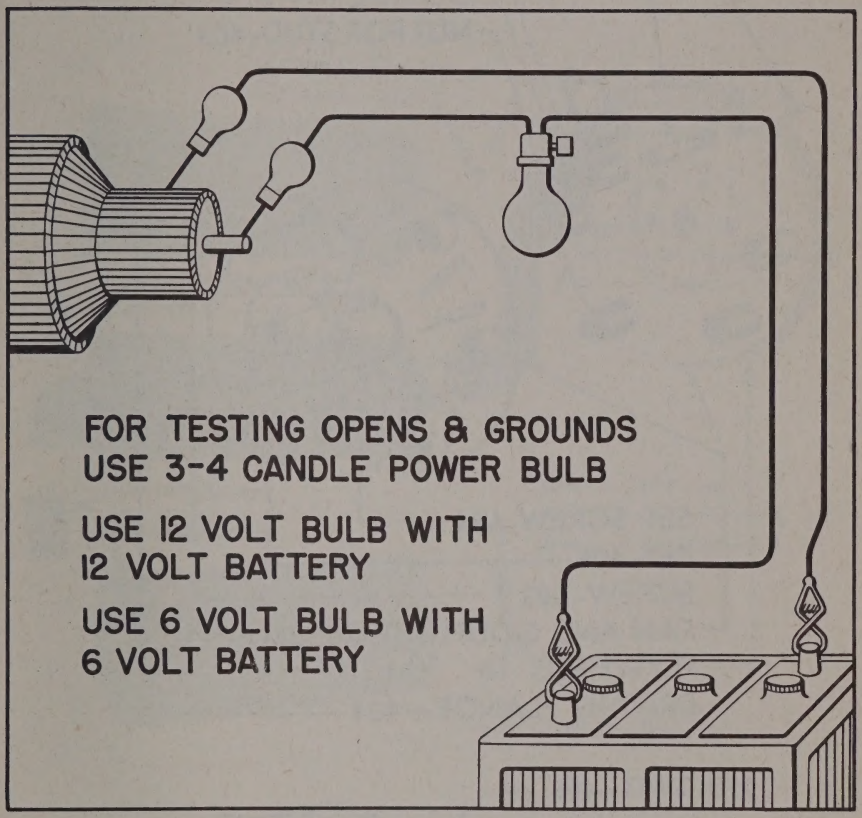
(4) Disconnect generator from skid (fig. 4). Use a ½-inch open-end wrench.

(5) Disconnect generator from fan and coupling housing (fig. 58).

(6) Loosen the two screws that hold flange key to the driving axle. Use a ⅜-inch open-end wrench.

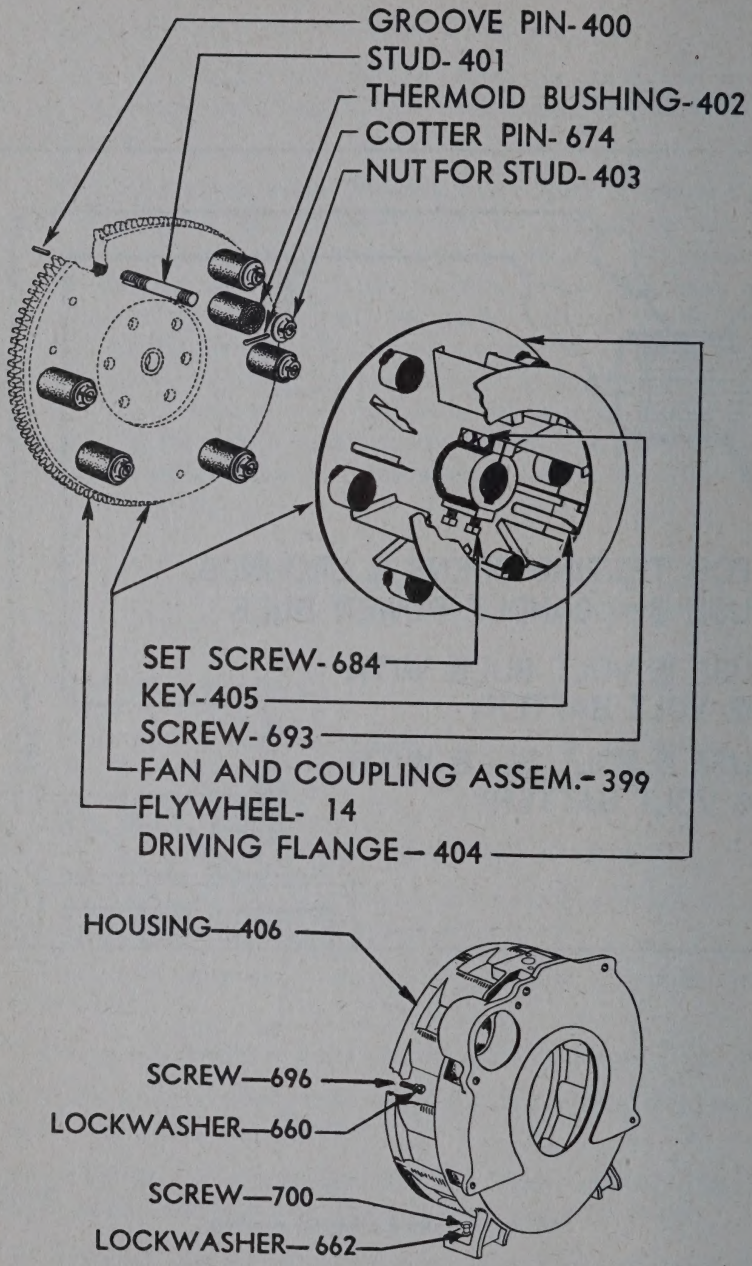
(7) Loosen the two screws that hold the flange assembly (fig. 58 (404)) to the generator axle. Use a 5/16-inch open-end wrench.

b. Reinstall the generator by using the reverse order of the above procedure.



TL-91874

Figure 57. Testing generator windings.



TL-94401

Figure 58. Bell housing, fan, and coupling assembly.

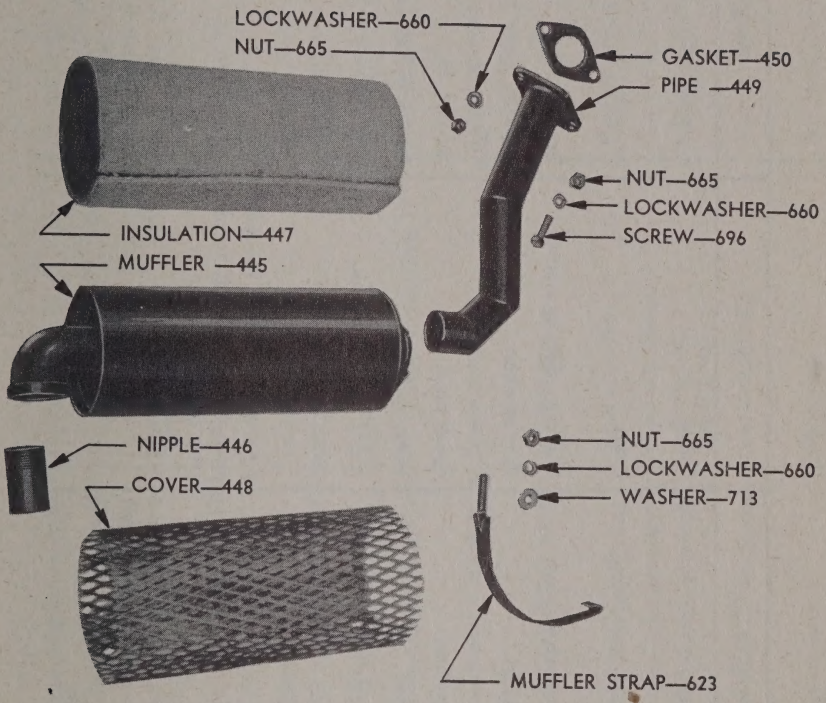


Figure 59. Muffler assembly and attaching parts.

62. TROUBLE AND REMEDY CHART.

a. Engine.

Symptom	*Possible cause*	*Check*	*Remedy*
Fails to start or hard to start.	Three-way fuel valve in wrong position.	Valve.	Place correctly.
	Oil pressure cut-off relay not working.	Relay.	Replace.
	Ignition switch shorted.	Magneto shorting contacts.	Remove short.
	Water in fuel.	Fuel strainer.	Remove water from fuel system.
	Faulty ignition.	Spark plug.	See par. 38.
	Lack of fuel.	Fuel supply.	Replenish fuel supply.
	Fuel not getting to carburetor.	Valve below gas tank.	Open valve.
	Small knob of ignition switch on RUN position.	Knob position.	Replace knob to ON position.
	No spark at cylinders.	Check for spark by removing wire from plug and turning over engine a few times.	Test spark plugs, magneto, capacitor, timing.
	After a stop, a sudden surge of temperature may cause high temperature emergency stop to operate.	Knob position.	Start with SAFETY-NO SAFETY switch in NO SAFETY position.

	Carburetor clogged or defective.	Carburetor	Prime engine by removing spark plugs and injecting gas in cylinders. Change carburetor.
	Loose sediment cup.	Sediment cup.	Tighten cup bracket nut.
	Carburetor or intake manifold loose.	Nuts and cap screws.	Tighten, or if necessary, replace gasket.
	Defective wiring.	Ignition wires.	Correct faults.
	Air filter clogged.	Filter.	Clean filter.
	Valves incorrectly adjusted.	Valve clearance.	Readjust valves.
Engine misfiring.	Loose connections in ignition system.	All ignition connections.	Correct fault.
	Dirty or defective spark plug or plugs.	Spark plugs.	Clean or replace faulty plugs.
	Breaker points out of adjustment.	Breaker points.	See. par. 37.
	Breaker points pitted.	Breaker points.	Replace points.
	One or more valves not closing properly.	Valve adjustment. Valve springs. Sticking valves.	Correct fault or report to high echelon of repair.
	Loose spark plug wire or wires.	Spark plug wires.	Tighten spark plug terminal nuts.
	Faulty carburetion.	Carburetor.	See pars. 28 and 31.

62. TROUBLE AND REMEDY CHART (Contd).

a. Engine.

Symptom	*Possible cause*	*Check*	*Remedy*
	Air leaks in intake system.	Carburetor flange manifold gaskets and fastenings. Cracks in intake manifold.	Correct fault.
Engine overheating.	Water passage clogged.	Water passage.	Drain and flush cooling system.
	Radiator frozen.	Radiator.	Thaw out. Open radiator drain cock to see if liquid flows.
	Lack of lubrication.	Crankcase oil level with bayonet gauge.	Replenish oil (par. 9).
	Muffler clogged.	Muffler.	Replace muffler.
	Incorrect valve adjustment.	Valve adjustment.	Readjust valves (par. 39).
	Carburetor float valve set too high.	Float valve.	Correct adjustment.
	Automatic choke not functioning properly.	Choke operation.	Correct fault, or disconnect.
	Air cleaner dirty.	Air cleaner.	Clean.
	Generator overload.	Load.	Correct load.
	Lack of cooling liquid in radiator.	Radiator.	Replenish liquid (par. 24 b).

	Loose fan belt.	Fan belt.	Tighten if loose. Replace if badly worn.
Engine heats and automatic cutoff shuts off engine	Little, or no water in radiator.	Water level in radiator.	Replenish water in radiator.
	Loose fan belt.	Fan belt.	See that it shows a 1" deflection when snapped with fingers.
	Low oil pressure.	Oil level and bearings.	Replenish oil in crankcase. Check for loose or tight bearings.
Engine runs irregularly.	Over-rich gasoline mixture.	Check by trial.	Adjust lean-rich mixture on carburetor.
	Cylinders firing irregularly.	Spark plugs by grounding out with screwdriver.	Defective cylinder will not cause change in speed or sound of exhaust. Check timing.
Engine knocks.	Loose bearings.	Stop engine, rock by using hand crank.	If bearing is defective, send to repair depot.
	Excessive carbon.	Cylinder head.	Clean cylinder head and piston head (par. 41).
	Fuel mixture too lean.	Close choke part way and note any improvement.	Correct float valve adjustment, or clean carburetor.
	Lack of lubrication.	Crankcase oil level.	Replenish oil.
	Loose flywheel.	Flywheel.	Report to higher echelon.

62. TROUBLE AND REMEDY CHART (Contd).

a. Engine.

Symptom	*Possible cause*	*Check*	*Remedy*
	Engine overheated.	Condition of cooling system, air intake, and ventilation.	Correct fault.
	Loose connecting rod or piston pin bearings.	Rock against compression with hand crank and feel for play.	Report to higher echelon of repair.
	Broken valve.	Compression. Remove cylinder head and check valves.	Report to higher echelon of repair.
	Incorrect timing.	Timing.	See pars. 37 and 43.
	Worn piston and/or cylinders.	Compression.	Return to depot.
Engine backfires.	Incorrect timing.	Timing.	See pars. 37 and 43.
	Fuel mixture lean.	Carburetor.	Correct adjustment of float. See par. 28.
	Intake valves not seating.	Compression.	Correct fault. See par. 42.
	Air leaks in intake manifold.	Leaks.	Correct fault.
	Intake valve springs weak.	Valve springs.	Replace springs.
	Intake valve warped or broken.	Compression, and valves.	Replace faulty valves.
	Intake tappets set too close.	Valve adjustment.	Readjust valves (par. 39).

	Intake valves sticking.	Compression. Valve stems for excessive carbon.	Clean valve stems.
Excessive smoking.	Upon first starting protective oil from cylinders not burned out.	Check further if excess continues after four or five minutes.	Allow to burn out.
	Too much oil.	Oil level with bayonet gauge.	Drain off any excess.
	Oil leaks from oil pan or connections.	Check visually.	Tighten connections, replace gaskets.
	Fuel mixture too rich.	Carburetor float level.	Readjust float level.
	Oil too light.	Body of oil.	Refill with oil of correct viscosity.
	Worn pistons, rings, or cylinder wall.	Compression.	Return to depot.
	Worn connecting rod.	Refer to engine knocks.	Return to depot.
Weak compression.	Operating with light or no load.	Operating conditions.	No remedy needed.
	Cylinder head gasket leaking.	Cylinder head cap screws.	Tighten cylinder head cap screw. If necessary, install a new gasket.
	Valves not seating properly.	Valves.	Correct faults. See par. 42.
	Valves sticking.	Valve action.	Clean valve stem.
	Valve tappets set too close.	Valve adjustment.	Readjust valves (par. 39).

62. TROUBLE AND REMEDY CHART (Contd).

a. Engine.

Symptom	*Possible cause*	*Check*	*Remedy*
	Piston rings and/or cylinder worn.	Rings and cylinder wall.	Return to depot.
Surging or uneven operation.	Lean mixture in carburetor.	Gradually close the choke. If mixture is lean, unit will speed up slightly and run more smoothly at a certain choke position.	Clean out fuel line. Remove carburetor and blow out dirt.
	Air leak in manifold.	Check exhaust noise at manifold.	Replace manifold gasket.
	At no load.	Check anti-surge screw position on governor.	Screw in anti-surge screw on governor (par. 32).
	Piston rings and/or cylinder worn.	Rings, and cylinder wall.	Return to depot.
Fuel leaks.	Loose sediment cup.	Sediment cup.	Tighten cup bracket nut.
	Faulty sediment cup gasket.	Gasket.	Replace gasket.
	Loose fuel line fittings.	Fittings.	Tighten fuel pump inlet and outlet fittings. Replace, if threads are stripped.
	Broken fuel pump diaphragm.	Diaphragm.	Replace diaphragm.
	Sticking valve.	Valve.	Free, or replace valve assembly.

Low fuel pressure.	Air leaks in system.	Connections.	Tighten connections.
	Pull rod assembly out of order (fig. 14 (365)).	Pull rod assembly.	Replace pull rod assembly.
	Sticking valve.	Valve.	Free, or replace valve assembly.
	Broken lever or diaphragm spring.	Lever and spring.	Replace spring.

62. TROUBLE AND REMEDY CHART (Contd).

b. Generator.

Symptom	*Possible cause*	*Check*	*Remedy*
Sparking at brushes.	Excessive load.	Load.	Reduce load.
	Brushes not seating properly. Dirty brushes and/or commutator.	Brushes, and commutator.	Replace and clean as necessary.
	Commutator pitted.	Commutator.	Clean as needed (par. 55).
	High mica on commutator.	Commutator.	Return to depot.
	Open circuit in exciter armature.	Armature.	Replace armature (par. 58).
	Open circuit in generator field rheostat lead.	Lead.	Repair lead.
A-c voltage low.	Engine not up to speed.	Frequency meter.	Check engine for cause.
	Dirt on exciter slip rings.	Slip rings.	Clean (par. 55).
	Worn exciter brushes.	Brushes.	Replace brushes (par. 56).
	Short, ground or opening in field circuit.	Field circuit.	Report to depot.
Frequency incorrect.	Engine speed is incorrect.	Governor.	Adjust engine governor (par. 32).
Generator fails to deliver voltage or amperage.	No load on generator.		Apply load.
	Circuit breaker off.		Close circuit breaker.

	Dirt on exciter rings.	Exciter rings.	Clean rings.
	Exciter brushes sticking.	Exciter brushes.	Clean, or replace brushes.
	Exciter brushes worn.	Exciter brushes.	Replace brushes (par. 56).
	Open circuit in field.	Field circuit.	Check and repair if possible; if not, return to depot (par. 60).
No voltage output.	Generator exciter or slip ring brushes not making contact with commutator and slip ring.	Check all brushes.	Push brushes down until they come in contact with commutator and slip ring.
	No residual magnetism in exciter field poles.	Check exciter voltage (should read about 65 volts).	Use a 6-volt storage battery and touch terminals to brushes on commutator.
	Excessive resistance in shunt field.	Check for breaks in wiring, open circuits and rheostat control.	Repair any breaks or opens, or change rheostats.
Generator overheated.	Overload on generator.	Load.	Reduce load.
	Cooling fan obstructed.	Fan air passages.	Clean.
SHOCKING.			
Shock upon touching unit.	Ground in alternator field winding.	By using 110-volt supply with a lamp of corresponding voltage in series and placing one terminal on field lead and the other terminal on generator lead.	Replace field winding.
	Ground in stator.	Repeat the above but place terminals to stator lead and frame.	Replace stator.

SECTION V. SUPPLEMENTARY DATA.

63. MAINTENANCE PARTS LIST FOR POWER UNIT PE-183-A.

Ref. symbol	*Ordnance stock No.*	*Name of part and description*	*Quantity per unit*	*Running spares*	*Orgn. stock*	*3d ech*	*4th ech*	*5th ech*	*Depot stock*
		BATTERY AND BATTERY CABLE GROUP							
	HB No. 10J246	CABLE ASSEMBLY: starter; negative; 8′ long; Hobart Bros. Co. 10J246.	1	1					×
	HB No. 10J245	CABLE ASSEMBLY: starter; positive; 8′ long; Hobart Bros. Co. 10J245.	1	1					×
		CAMSHAFT GROUP							
22	WO No. 51460	PLUG: expansion; 1¾″; Willy's 51460.	1	1					×
		CRANKSHAFT AND CONNECTING ROD GROUP							
88	WO No. A7233	BEARING: set; connecting rod; for Willy's MB engine; Willys A7233. Consists of 2 Willys 639862 std. bearings (FM GPW6211A).	1	1					×
		CYLINDER BLOCK, CRANKCASE, AND GEAR COVER GROUP							
34	WO No. 638678	GASKET: cylinder head; (for Willys MB engine); Willys 638678.	1	1					×
72	WO No. 51091	PLUG: expansion; 1¼″; Willys 51091.	5	5					×
		FUEL PUMP GROUP							
351	WO No. A1220	PUMP: fuel; AC1537766; Willys A1220.	1	1					×

		GOVERNOR AND GOVERNOR CONTROL GROUP								
479	KS No. 26710	GOVERNOR: assembly; centrifugal; King-Seeley 26710.	1	1						×
		IGNITION GROUP								
193	WCE No. X1408	ARM: breaker; Wico X1408.	1	1						×
208	WCE No. 1413	CAPACITOR: magneto; Wico X1413.	1	1						×
198	WCE No. 1196	POINT: magneto breaker; fixed contact; Wico 1196.	1	1						×
25	WO No. 538	SPARK PLUG: Champion QM2; Willys A538.	4	4						×
		OIL FILTER AND OIL LINE GROUP								
271	WO No. A1236	ELEMENT: oil-filter; with gasket; for Purolator PD51; Willys A1236; Ford Motor, GPW18662B.	1	1						×
		RADIATOR GROUP								
460	AMC	CLAMP: hose; radiator; 1½"; 3-ply; No. 10½ American Stamping.	6	6						×
461	HB No. 25J172	HOSE: radiator; for inlet connections; 1½" ID x 3½" long; Hobart Bros. Co. No. 25J172.	2	2						×
464	HB No. HJ13	HOSE: radiator; for outlet connection; 1½" ID x 5" long; Hobart Bros. Co. HJ13.	1	1						×

×To be requisitioned from Ordnance Depots as per ASF directive dated 16 Sep. 1943, S. P. M. T. 400.4, serial No. 64.

63. MAINTENANCE PARTS LIST FOR POWER UNIT PE-183-A (Contd).

Ref. symbol	*Ordnance stock No.*	*Name of part and description*	*Quantity per unit*	*Running spares*	*Orgn. stock*	*3d ech*	*4th ech*	*5th ech*	*Depot stock*
52	WO No. 637646	THERMOSTAT: water temperature; bellows type; Willys 637646.	1	1					×
		VALVE GROUP							
125	WO No. 375994	LOCK: retainer; valve spring; lower; Willys 375994.	16	8					×
124	WO No. 637044	RETAINER: valve spring; lower; Willys 637044.	8	4					×
123	WO No. 638636	SPRING: valve; Willys 638636.	8	4					×
122	WO No. 637183	VALVE: exhaust; Willys 637183.	4	4					×
		WATER PUMP AND FAN GROUP							
19	WO No. A1495	BELT: fan and idler assembly drive; Willys A1495.	1	1					×
286	WO No. A6839	KIT: repair; water pump; Willys A6839;	1	1					×
288 289 290 294		consists of: 1 bearing and shaft assembly, Willys 636297; 1 bearing retainer wire, Willys 636298; 1 seal assembly, Willys 640031; 1 seal washer, Willys 640034; 1 water pump to cylinder block gasket, Willys 637053.							

		MISCELLANEOUS GROUP								
	WO No. A1536	GASKET: complete set; for Willys MB engine; Willys A1536; FM GPW6051B; consists of the following:	1	1						×
62	WO No. 630365	GASKET: chain-cover; Willys 630365; Ford GPW6288.	1							×
63	WO No. 630359	GASKET: cylinder block; front; Willys 630359; Ford GPW6020.	1							×
34	WO No. A8558	GASKET: cylinder head; Willys A8558; Ford GPW6051B.	1							×
	WO No. 634814	GASKET: exhaust pipe flange; Willys 634814; Ford GPW9450.	1							×
371	G-085-30-02240	GASKET: fuel pump; Willys 638737; Ford GPW9417.	1							×
	WO No. A6357	GASKET: insulator and diffuser assembly; Willys A6357; Ford GPW9445.	1							×
35	G-503-01-94021	GASKET: intake and exhaust manifold; Willys 638640; Ford GPW9448.	1							×
36	WO No. 634811	GASKET: intake to exhaust manifold; Willys 634811; Ford GPW9435.	1							×
	WO No. 630398	GASKET: intake to exhaust manifold; Willys 630398; Ford GPW6627.	1							×
4	WO No. 630398	GASKET: oil float support; Willys 630398; Ford GPW6627.	1							×

×To be requisitioned from Ordnance Depots as per ASF directive dated 16 Sep. 1943, S. P. M. T. 400.4, serial No. 64.

63. MAINTENANCE PARTS LIST FOR POWER UNIT PE-183-A (Contd).

Ref. symbol	*Ordnance stock No.*	*Name of part and description*	*Quantity per unit*	*Running spares*	*Orgn. stock*	*3d ech*	*4th ech*	*5th ech*	*Depot stock*
		MISCELLANEOUS GROUP (contd).							
7	WO No. 639980	GASKET: oil pan; Willys 639980; Ford GPW6710.	1						×
263	WO No. 639870	GASKET: oil pump cover (vellumoid); Willys 639870; Ford GPW6659.	1						×
	WO No. 630392	GASKET: oil pump cover; Willys 630392; Ford GPW6619.	2						×
8	3320-GFW-6734	GASKET: oil pan drain-plug; Willys 314338; Ford B12410.	1						×
262	WO No. 375927	GASKET: oil pump shaft; Willys 375927; Ford GPW6625.	1						×
267	WO No. 630394	GASKET: oil pump to cylinder block; Willys 630394; Ford GPW6630.	1						×
251	WO No. 634813	GASKET: oil pump relief spring retainer; Willys 634813; Ford GPW6642.	1						×
94	WO No. 334103	GASKET: crankshaft oil-slinger; Willys 334103; Ford GPW6353.	1						×
69	WO No. 637790	PACKING: crankshaft bearing-cap; Willys 637790; Ford GPW6701.	2						×
26	WO No. 637863	GASKET: spark plug; Willys 637863; Ford 01A-12410.	4						×

37	G-503-01-94022	GASKET: valve spring cover; Willys 630305; Ford GPW6521.	1							×
38	G-503-01-94032	GASKET: valve cover screw; Willys 51875; Ford GPW6555.	2							×
39	G-503-01-94030	GASKET: water outlet elbow; Willys 639650; Ford GPW8255.	1							×
294	G-503-01-94016	GASKET: water pump to cylinder block; Willys 637053; Ford GPW8543.	1							×
17	WO No. 637098	PACKING: crankshaft; front; Willys 637098; Ford GPW6700.	1							×
12	WO No. 637237	PACKING: crankshaft; rear; Willys 637237; Ford GPW6702.	1							×
33	WO No. 630299	GASKET: ventilator to valve-spring cover; Willys 630299; Ford GPW6648.	1							×

×To be requisitioned from Ordnance Depots as per ASF directive dated 16 Sep. 1943, S. P. M. T. 400.4, serial No. 64.

63. MAINTENANCE PARTS LIST FOR POWER UNIT PE-183-A (Contd).

Ref. symbol	Signal Corps stock No.	Name of part and description	Quantity per unit	Running spares	Orgn. stock	3d ech	4th ech	5th ech	Depot stock
		GENERATOR AND EXCITER GROUP							
409	3H304-27	BEARING: ball; for arm shaft; New Departure WC8507X; Fafnir 207T.	1	1		*	*		*
413	3H4540.1/7	BEARING: ball; engine end of generator; Fafnir 308.	1	1		*	*		*
443	3H106H-1/B5	BRUSH: a-c; 0.245" x 0.260" x 1½"; SAE 35 grade, Nat'l Carbon Co.; 472G grade Superior Carbon Co.; for alternator; Hobart Bros. Co. DW825.	4	4	*	*	*	*	*
444	3H105-1/B6	BRUSH: d-c; 0.370" x 0.621" x 1½"; 3A-35 or 259 grade Nat'l Carbon Co.; 472G grade, Superior Carbon Co.; for exciter; Hobart Bros. Co. AAP-16A.	4	4	*	*	*	*	*
	3DA100-268	CAPACITOR: tubular; bearing bracket; 0.1-mf, 400v dc (working); ¾" diam. tinned case; capacitor body 2" long with 2¾" lead soldered lug; 5/32" hole in bracket.	2				*	*	*
417	6Z4329-5	COUPLING: pipe; steel; ⅛".	1				*	*	*
418	6Z3460-1	CUP: grease; ⅛"; No. 000 male.	1				*	*	*
422	6Z7245-2.1	NIPPLE: pipe; steel; black; ⅛", 5" long.	1				*	*	*

434	2C4923A/T6	SPRING: brush; No. 14; 0.064″ diam.; phosphor bronze wire; Hobart Bros. Co. No. W799-6.	8			*	*	*	*
		CONTROL GROUP							
596	3F2746	FREQUENCY METER: miniature type MF9; Frahm vibrating reed; 59 to 62 c; 9 reeds; 125-v; 2¾″ diam. x 3″ deep from back of flange; James G. Biddle Co.	1				*	*	*
609	6Z6820-21	LAMP: 25w, 120v; silver bowl; A-19; rough service lamp.	2		*	*	*	*	*
599	6Z7778	RECEPTACLE: twist lock; Hubbell 7380.	1			*	*	*	*
597	3Z7032	RHEOSTAT: field; 32-ohm; wire-wound; Ohmite Model L, Ohmite Spec 10821 or Hardwick-Hindle type D-150.	1			*	*	*	*
598	3F3320-1	TIMEMETER: range 9,999.9 hours; 115v, 60c; case diam. 2¾″; flange diam. 3½″; R. W. Cramer, RT2H.	1				*	*	*
	6Z8355-2	SOCKET: panel light; 125 v; rubber-insulated; Daniel Woodhead 604; lamp holder.	2				*	*	*
595	3Z9859	SWITCH: light; toggle; with bussing back terminals; Cutler-Hammer 7320.	1			*	*	*	*
	3H106H-1	ALTERNATOR: 6.3 kva, 120 v ac, 60 c single-phase; Hobart Bros. Co. 10J292.	1						*

*Indicates stock available at Signal Corps Depots.

63. MAINTENANCE PARTS LIST FOR POWER UNIT PE-183-A (Contd).

Ref. symbol	*Signal Corps stock No.*	*Name of part and description*	*Quantity per unit*	*Running spares*	*Orgn. stock*	*3d ech*	*4th ech*	*5th ech*	*Depot stock*
		CONTROL GROUP (contd).							
604	3F1075	AMMETER: a-c; 0.75 amps; all bakelite case; white face; black lettering; mounts in 2½" diam. round window; flange diam. 3 11/16"; linear distance between mounting holes in flange, 2¾"; 3-screw mounting; Triplett Model 331JP.	1				*	*	*
	3DA10-32	CAPACITOR: power studs to ground; 0.01-mf, 400 v dc (working); ¾" diam. case with bracket soldered on; body 2" long with 1½" lead; tinned lug; 5/32" hole in bracket for mounting.	4				*	*	*
605	3H900-70-2	CIRCUIT BREAKER: thermal; 2-pole; 125 v, 70 amps; molded black bakelite case, 5¼" x 3" x 2¾"; toggle action; manual re-set; Heineman 0322.	1			*	*	*	*
	3H4109-3	CONTROL PANEL ASSEMBLY: complete with instruments for Power Unit PE-183-A; Hobart Bros. Co. 10J143.	1				*	*	*

603	3F8150-84	VOLTMETER: a-c; 0-150 v; all-bakelite case; white face; black lettering; 3-screw mounting; mounts in 2½" diam. round window; flange diam. 3 11/16"; linear distance between mounting holes in flange; 2¾"; Triplett No. 331JP.	1				*	*	*
	6Z7789-1	RECEPTACLE: double convenience outlet; Arrow-Hart & Hegeman Co. 1913.	1			*	*		*

*Indicates stock available at Signal Corps Depots.

64. TABLE OF STANDARD BOLTS, NUTS, SCREWS, WASHERS, AND COTTER PINS.

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
639	4	1/4	5/8	20	Bolt: hex. head, cap.	Mounts fan to pulley.
640	1	5/16	5/8	24	Bolt: hex. head, cap.	Mounts starting motor support to starting motor.
641	4	5/16	3/4	24	Bolt: hex. head, cap.	Mounts filter to bracket.
642	7	5/16	7/8	18	Bolt: hex. head, cap.	2-mount fuel pump to cylinder block. 3-mount water pump to cylinder block. 2-mount fuel pump to engine.
643	4	5/16	1	18	Bolt: hex. head, cap.	Mounts exhaust to intake manifold.
644	1	5/16	1 1/4	18	Bolt: hex. head, cap.	Mounts brace to idler pulley.
645	3	5/16	1 5/8	24	Bolt: hex. head, cap.	Mounts governor to engine.
646	2	5/16	1 3/4	20	Bolt: hex. head, cap.	Mounts idler assembly.
647	1	5/16	2 1/2	18	Bolt: hex. head, cap.	Mounts water pump to cylinder block.
648	3	3/8	7/8	16	Bolt: hex. head, cap.	1-mounts starting motor support to crankcase. 2-mount idler support assembly.
649	12	3/8	1	24	Bolt: hex. head, cap.	Mounts timing chain cover to engine.
650	1	3/8	1 1/8	24	Bolt: hex. head, cap.	Mounts idler guide to brace.

651	2	3/8	1¼	16	Bolt: hex. head, cap.	1-mounts starting motor to rear engine plate and bell housing. 1-mounts starting motor to rear engine plate and bell housing and also mounts oil can holder bracket.
652	1	½	1½	13	Bolt: hex. head, cap.	Engine panel negative terminal.
653	2	#8			Lockwasher: std.	Mounts receptacle to control panel.
654	4	#10			Lockwasher: std.	Mounts circuit breaker to control panel.
655	4	3/16			Lockwasher: Std.	2-mount voltage regulator bracket to control panel. 2-mount voltage regulator to control panel mounting pan.
656	8	10			Lockwasher: steel.	4-mount commutator end plate assembly to starting motor armature housing. 4-mount pinion housing to starting motor housing.
657	13	¼			Lockwasher: steel.	4-mount fan to pulley. 1-mounts idler pulley shaft. 4-mount gas tank to gas tank and control panel mount. 2-mount oil can holder. 2-mount T-valve that holds filtrap to battery box mount.

64. TABLE OF STANDARD BOLTS, NUTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
658	23	5/16			Lockwasher: steel.	1-mounts starting motor support to starting motor. 6-mount fan pulley shield and oil pan to cylinder block. 14-mount oil pan to cylinder block and front engine cover. 2-mount radiator braces.
659	48	5/16			Lockwasher: steel.	4-mount oil filter clamp assembly to bracket. 2-mount oil float support to crankcase. 4-mount exhaust to intake manifold. 2-mount fuel pump to cylinder block. 3-mount bearing cap at front of generator. 3-mount bearing cap at rear of generator. 2-mount carburetor to manifold. 3-mount governor to engine. 2-mount fuel pump to engine. 1-mounts brace to idler assembly. 8-mount all mounts to skid. 2-mount battery box mount to fan and coupling housing. 1-mounts idler commutation head. 1-mounts idler drive end head assembly. 4-mount water pump to cylinder block. 2-mount starting motor's terminal post. 4-mount radiator guard.

660	42	3/8			Lockwasher: steel.	2-mount radiator to radiator mount. 4-mount exciter brushholder ring; inner and outer. 3-mount water outlet elbow. 4-mount cover to engine plate. 6-mount engine plate and chain cover to cylinder block. 6-mount flywheel bolt. 1-mounts starting motor to rear engine plate and bell housing. 1-used with ref. No. 600.. 1-mounts idler assembly. 1-mounts starting motor support to crankcase. 8-mount fan and coupling bell housing to generator housing. 2-mount idler support assembly. 2-mount exhaust pipe assembly to manifold assembly. 1-mounts muffler strap.
661	2	7/16			Lockwasher.	1-mounts battery box mount (right side) to engine. 1-mounts battery box mount (left side) to engine.

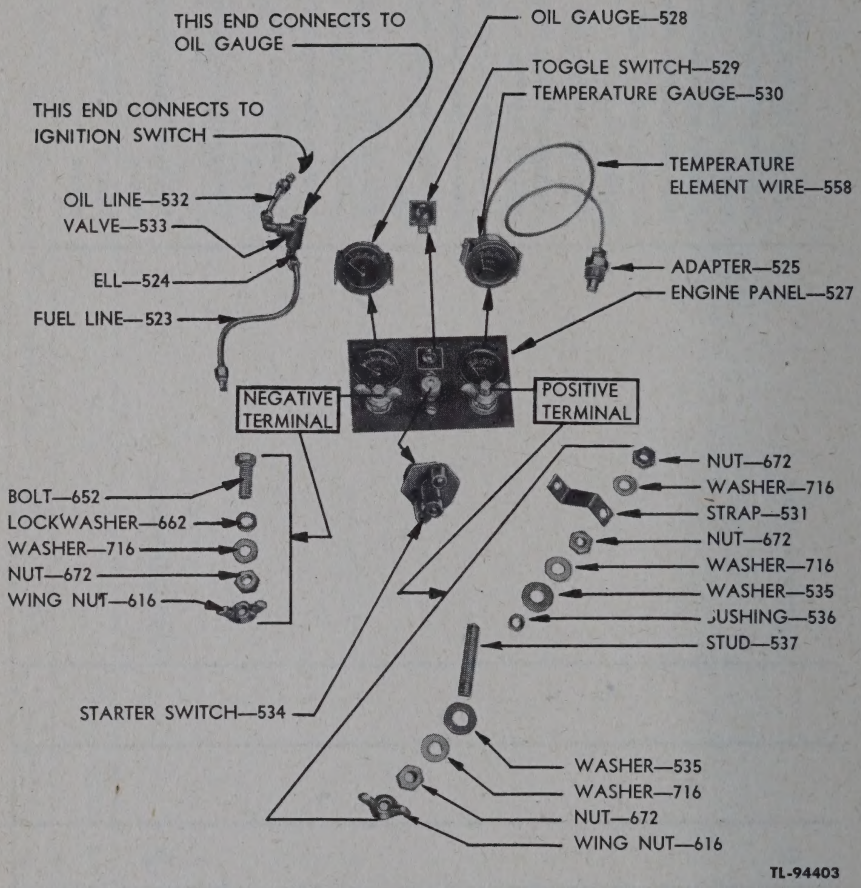


Figure 60. Engine panel and component parts.

64. TABLE OF STANDARD NUTS, BOLTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
662	15	1/2			Lockwasher.	6-mount bearing cap and crankcase screw. 1-mounts idler shaft to idler support assembly. 1-mounts engine panel negative terminal. 2-mount fan and coupling bell housing to skid. 1-mounts idler assembly. 4-mount generator to skid.
663	4	1/4		28	Nut: hex., jam.	3-hold fast throttle rod adjustment. 1-mounts idler pulley shaft.
664	16	3/8		16	Nut: hex., jam.	8-mount terminal block stud to control panel. 4-mount lugs to terminal block stud. 4-mounting external electrical equipment.
665	7	3/8		16	Nut: hex., jam.	2-mount pipe assembly to manifold. 1-holds muffler clamp secure. 4-mount Penn electric switch to engine panel.
666	1	10		24	Nut: hex., jam.	Mounts heat control crank lever to heat control shaft.

64. TABLE OF STANDARD BOLTS, NUTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
667	6	5/16		24	Nut: hex., jam.	2-mount starting motor terminal post. 1-mounts idler pulley. 2-mount carburetor to manifold. 1-mounts idler brace and handle assembly.
668	25	3/8		24	Nut: hex., jam.	4-mount cover to engine plate. 6-mount engine plate and chain cover to cylinder block. 7-mount intake and exhaust manifolds to engine block. 2-mount flywheel dowel. 4-mount flywheel bolt. 2-mount radiator to radiator mount.
669	8	7/16		20	Nut: hex., jam.	6-mount cylinder head. 1-mounts cylinder head stud No. 12 hole. 1-mounts cylinder head stud No. 10 hole.
670	6	#8		32	Nut: hex., brass.	2-mount receptacle to control panel. 2-mount voltage regulator bracket to control panel. 2-mount voltage regulator bracket to control panel mounting pan.
671	2	1/2		13	Nut: standard wing.	Mounting terminal of battery cable.

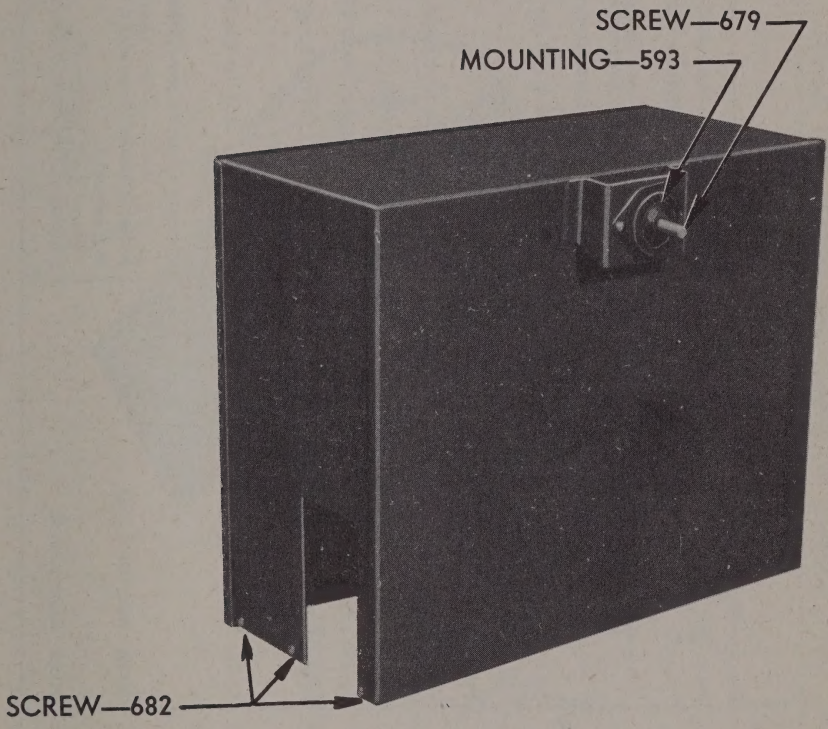


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Figure 61. Control panel box assembly.

64. TABLE OF STANDARD BOLTS, NUTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
672	9	½		13	Nut: hex., jam.	4-mount generator to skid. 1-mounts idler shaft to idler support assembly. 1-mounts engine panel negative terminal. 3-mount engine panel positive terminal.
673	2	1¼		8	Nut: hex., jam.	Mounts connecting rod that holds front and rear skid intact.
674	6	⅛	1		Pin: steel, cotter.	Locks stud nut.
675	1	⅛	1¼		Pin: cotter.	Mounts oil float to support.
676	4	#8	⅜		Screw: type Z self-tapping.	Mounts crank clips.
677	4	#8	½		Screw: self-tapping.	Mounts air cleaner to air cleaner brace.
678	2	¼	½	20 NC	Screw: Allen head cup point set.	Mounts seal to body flange gas tank safety cap assembly.
679	5	¼	⅞	24 SAE special	Screw: hex. head, cap.	4-mount gas tank to gas tank and control panel mount. 1-mounts control panel box to gas tank.
680	2	¼	1	20 NC	Screw: hex. head, cap.	Mounts battery box mount to fan and coupling housing.
681	4	3/16	5/16	24 SAE	Screw: countersunk.	Mounts battery box to battery-box mount.

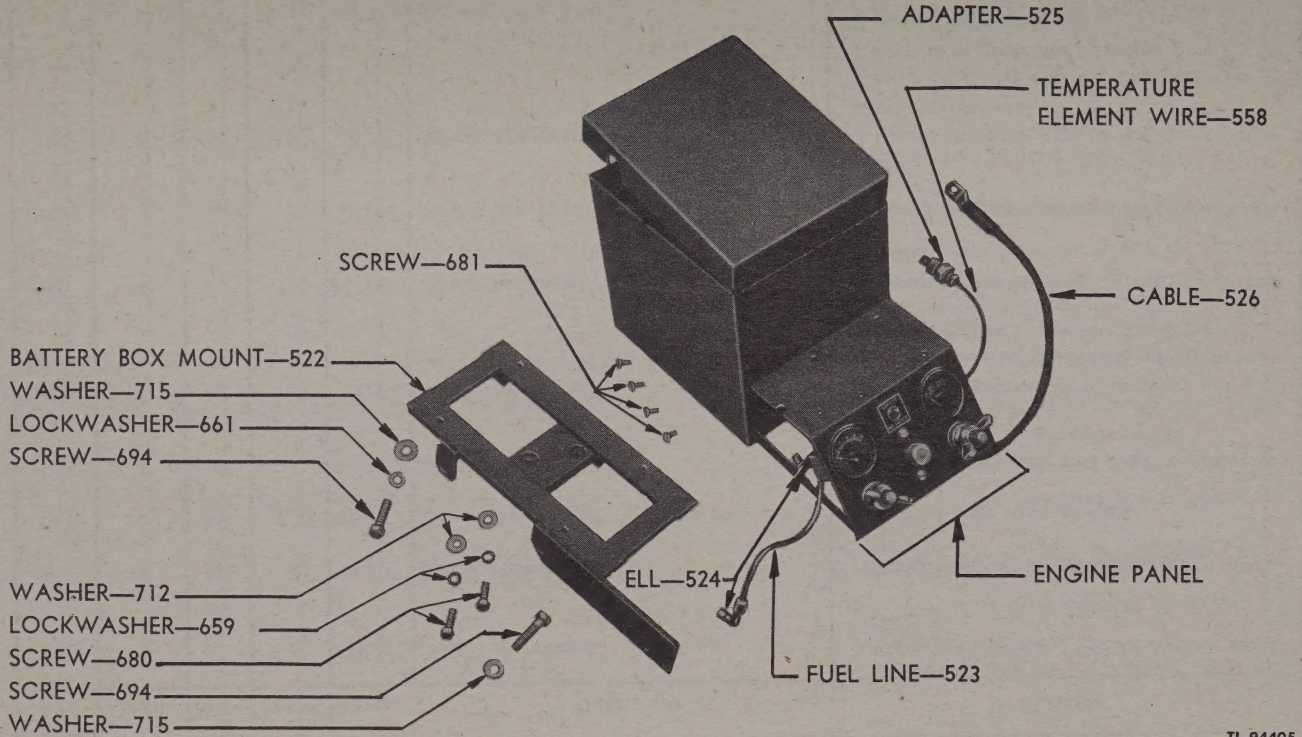

Figure 62. Battery box assembly.

64. TABLE OF STANDARD NUTS, BOLTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
682	6	3/16	1/2	24 SAE	Screw: roundhead.	Mounts control panel box to control panel mount.
683	4	3/8	1/2	24 NF	Screw: roundhead.	Mounts Penn electric switch to engine panel.
684	2	3/8	1	16 NC	Screw: Squarehead cup point set.	Mounts flange to crankshaft.
685	4	10	3/8	32 SAE	Screw: fillister head.	Mounts commutator end plate assembly to starting motor armature housing.
686	4	1/4	1/2	20 NC	Screw: roundhead.	2-mount oil can holder to bracket. 2-mount T-valve (that holds filtrap) to battery box mount.
687	4	10	31/32	32 SAE	Screw: hex. head, cap.	Mounts pinion housing to starting motor housing.
688	1	1/4	5/8	20 NC	Screw: hex. head, cap.	Mounts magneto advance control arm assembly.
689	8	5/16	1/2	18 NC	Screw: hex. head, cap.	3-mount bearing cap to exciter bearing bracket—rear end. 3-mount bearing cap to spacer bracket—front end of generator assembly. 2-mount radiator braces.

690	20	5/16	5/8	18 NC	Screw: hex. head, cap.	4-mount fan pulley shield and oil pan to cylinder block. 16-mount oil pan to cylinder block and front engine cover.
691	8	5/16	3/4	18 NC	Screw: hex. head, cap.	2-mount right radiator brace. 4-mount control panel support to skid assembly. 2-mount oil float support to crankcase.
692	8	5/16	1	18 NC	Screw: hex. head, cap.	2-mount radiator mount to skid. 1-mounts left motor mount. 1-mounts right motor mount. 4-mount panel box and gas tank mount.
693	2	5/16	1 1/4	24 NF	Screw: hex. head, cap.	Mounts flange to crankshaft.
694	2	5/16	1 3/8	20 SAE special	Screw: hex. head, cap.	Mounts battery box mount to engine.
695	3	3/8	1 1/8	16 NC	Screw: hex. head, cap.	Mounts water outlet elbow.
696	13	3/8	1 1/4	16 NC	Screw: hex. head, cap.	4-mount exciter bearing bracket to generator. 8-mount fan and coupling bell housing to generator housing. 1-mounts exhaust pipe assembly to manifold assembly.
697	8	3/8	1 1/2	16 NC	Screw: hex. head, cap.	4-mount exciter pole piece to exciter bearing bracket. 4-mount shock absorber between control panel mounting pan and control panel support.

64. TABLE OF STANDARD BOLTS, NUTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
698	2	3/8	2	16 NC	Screw: hex. head, cap.	Mounts generator to engine.
699	4	3/8	2 3/4	16 NC	Screw: hex. head, cap.	Mounts exciter brushholders both outer and inner rings.
700	6	1/2	1 1/2	13 NC	Screw: hex. head, cap.	4-mount generator to skid assembly. 2-mount fan and coupling bell housing to skid.
701	6	#8	3/8	32 SAE	Screw: roundhead, machine.	4-mount breaker switch to panel. 2-mount receptacle to control panel.
702	10	#10	3/8	24 SAE	Screw: roundhead, machine.	Mounts shock absorber plate to control panel mounting pan bracket.
703	4	#10	5/8	24 SAE	Screw: roundhead, machine.	2-mount voltage regulator bracket to control panel. 2-mount voltage regulator bracket to control panel mounting pan.
704	1	#10	3/4	24 SAE	Screw: roundhead, machine.	Mounts heat control crank lever to heat control shaft.
705	2	1/4	3/4	20 NC	Screw: roundhead, machine.	Mounts brush cover to exciter bearing bracket.

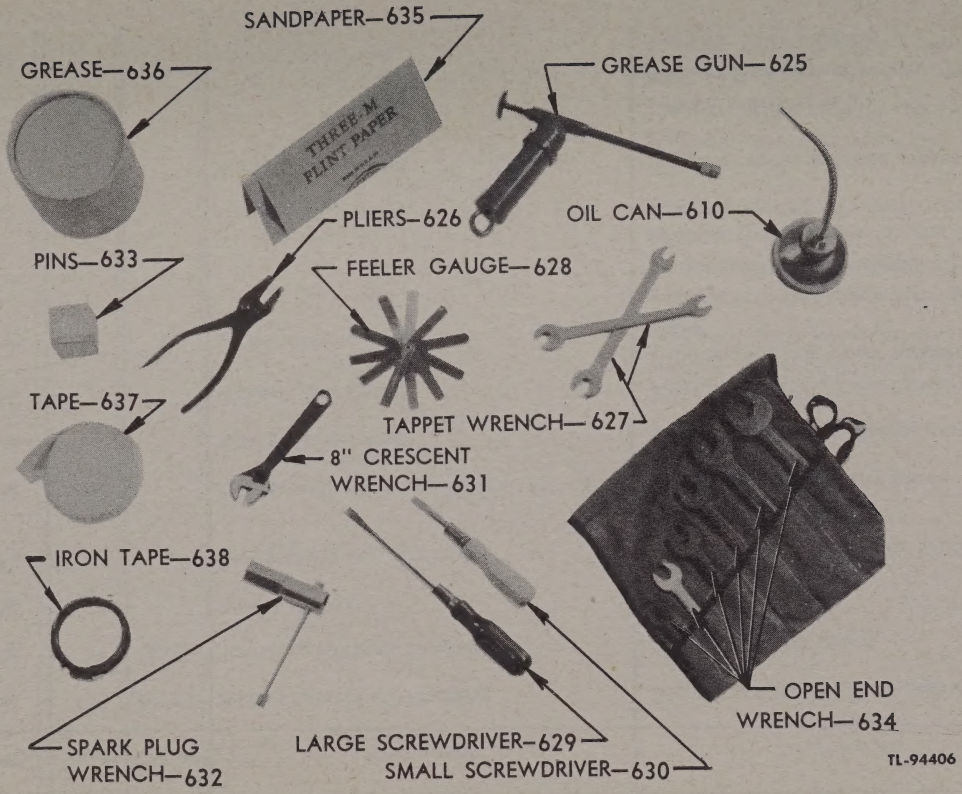

Figure 63. Tools.

64. TABLE OF STANDARD NUTS, BOLTS, SCREWS, WASHERS, AND COTTER PINS (Contd).

Ref. No.	*Quan.*	*Size*	*Length*	*Thread*	*Description*	*Function*
706	2	1/4	1 1/2	20 NC	Screw: roundhead, machine.	Mounts starter switch to engine panel.
707	4	5/16	5/8	24 NF	Screw: roundhead, machine.	Mounts radiator guard.
708	4	5/32			Washer: brass.	Mounts crank clips.
709	2	3/16			Washer: std. wrought iron.	Mounts voltage regulator bracket to control panel mounting pan.
710	4	1/4			Washer: vulcoid or equivalent 1 1/8" OD.	Mounts studs to control panel.
711	1	1/4			Washer: plain, steel.	Mounts idler pulley shaft.
712	11	5/16			Washer: plain, steel.	4-mount oil filter clamp assembly to bracket. 1-mounts starting motor support to starting motor. 1-mounts starting motor terminal post. 3-mount governor to engine. 2-mount battery box mount to fan and coupling housing.
713	7	3/8			Washer: plain, steel.	1-mounts starting motor support to crankcase. 1-mounts muffler strap. 4-mount Penn electric switch to engine panel. 1-mounts idler assembly.

714	26	3/8			Washer: bolt, steel.	8-mount terminal block stud to control panel. 8-mount lugs to terminal block stud. 10-mount exciter brushholders both outer and inner rings.
715	2	7/16			Washer: plain, steel.	1-mounts battery box mount (right side) to engine. 1-mounts battery box mount (left side) to engine.
716	9	1/2			Washer: plain, steel.	1-mounts engine panel negative terminal. 3-mount engine panel positive terminal. 1-mounts idler assembly. 4-mount idler shaft to idler support assembly.

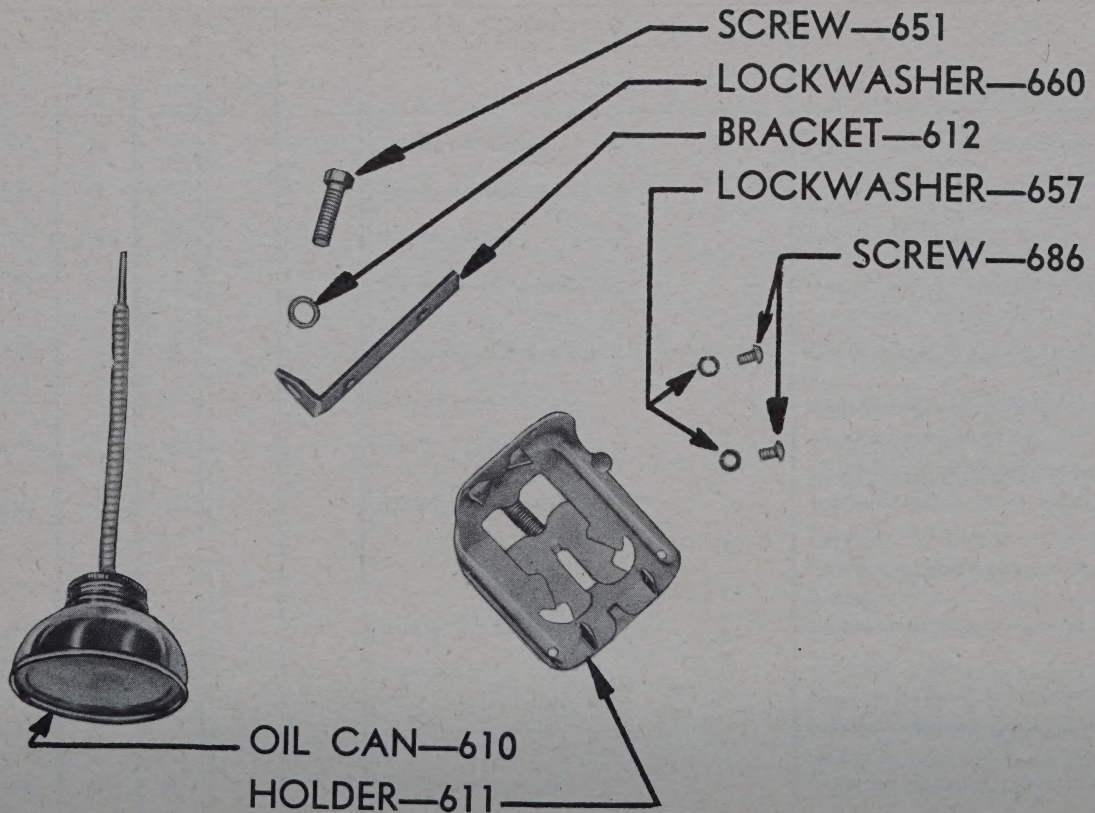

Figure 64. Oil can, holder, bracket, and attaching parts.

65. LIST OF TOOLS (fig. 63).

Ref. No.	*Quan.*	*Name and description*	*Ref. No.*	*Quan.*	*Name and description*
625	1	Pressure grease gun.	632	1	Spark plug wrench.
626	1	Gas pliers.	633	1	Cotter pins—small assorted.
627	2	Tappet wrench.	634	1 set	Wrenches—open end.
628	1	Feeler gauge.	635	2 sheets	Sandpaper No. 00.
629	1	Screwdriver (large).	636	1	Grease—2-lb. can.
630	1	Screwdriver (small).	637	1	Asbestos tape—1¼" x 25' roll.
631	1	Crescent wrench 8".	638	1	Tape--soft iron, 25'.